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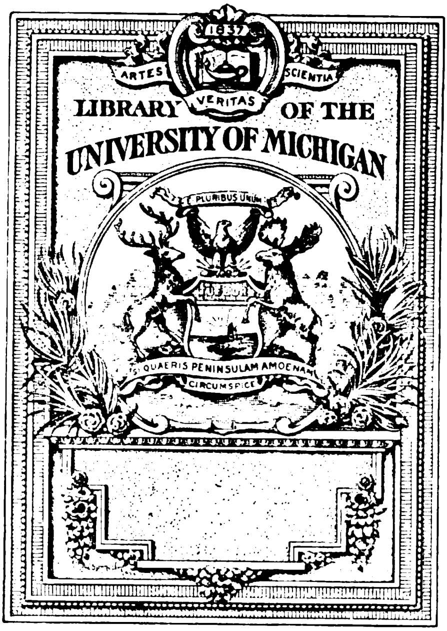

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NO. 1.

BULLETIN

OF THE

EXPERIMENT STATION

OF

FLORIDA,

AT THE

STATE AGRICULTURAL COLLEGE.

LAKE CITY, FLA.

APRIL, 1888.

J. KOST, M. D., LL. D. Director.

JACKSONVILLE, FLA.,
Times-Union Book and Job Printing.
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INTRODUCTION.

The Director of this Station is not without a deep sense that his work is, in a great degree, a peculiar one, owing to the latitudinal and climatic characteristics of Florida. Other stations have helps from correspondent and analagous surroundings that afford mutual advantages in station work. But the Florida Station, located on a peninsula between ocean and sea, alone, must largely work out its own materials. Already various letters of earnest solicitude have come in, asking of us not to fail making the most of our *"peculiar position."* Hence the consciousness of responsibility is all the greater.

If, as is evident, this Station is expected to determine the possibilities of the culture, in Florida, of tropical plants, and test the acclimation of species of opposite climates, as also the careful examination of the Florida soils and products, which in various respects are peculiar, then surely the work here is an important one.

Since the station work contemplates alike the conditions of *success* and the causes of *failure* in the culture of plants and rearing of animals, the analyses of soils, researches in vegetable and animal physiology, as also the study of the most approved methods of husbandry and appliances, as also the availments of the applied sciences, in what these mean in handling the soil and its products, then most evidently this station work is a great one. But we are fully resolved to do our part to prove the wisdom of those far seeing men in Congress who secured the means to effect this great national enterprise. The American people must ever be known as in the front rank in those great national movements that promote the highest civilization and chief good of humanity.

The introduction of articles in these bulletins will not be in systematic order; this the very nature of the work must preclude; but in handling the materials every availment of science and the improved arts will be placed in contribution. While kindliness in criticisms is hoped for, and a lack of assurance is acknowledged at the outset, our resolutions are strong for winning a grand success.

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AGRICULTURAL SECTION.

GRASSES.

Bayard Taylor once stated that the lawn is the chief part of a home. Whether this be so or not, it is certain that the pastoral life was the most primitive, and it would be a most interesting study to know how surely all animate beings are dependent upon the vegetable world. Grasses, though most humble, are yet most important of all vegetables.

TIMOTHY. (*Phleum Pratense.*)

The chief object of experimentation with timothy in this Station is to ascertain the conditions of its successful culture in the South.

All know the importance of timothy among the grazing and forage producing grasses in the North, and its facility of cultivation. But it is otherwise here. Timothy is not seen in meadows here. One coming South from Ohio fails not to see how constantly the appearance of the country changes as he proceeds southward. Timothy, clover and bluegrass are seen all along through Kentucky and some way on in Tennessee, but thenceforward meadows occur only in narrow strips along streams. Georgia, even in the northern part, presents no extensive pasture fields. When Florida is reached no pasture fields except fallows or wastes are to be observed. One going along feels strange, and begins to ask instinctively why is this strangeness of appearance? The solution is easy—*timothy* grows not here. But why not? Well, this is one of the questions whose solution is sought in the work of this Station.

Is the climate too hot for timothy? No, this is not a sufficient reason, since just as great a heat in summer occurs in Ohio, where timothy prospers. Is the season too long? This doubtless is one reason, but the timothy often dies here before the summer is half over. Is it owing to drouth? Perhaps in part, but drouths are exceptional largely. Is it because the lands are too sandy? Perhaps in part, but we have clay lands in Florida, and many that are loamy. Is it because we do not yet know the conditions in culture necessary in Florida for successful growing of timothy? This may be the chief fact, and faithful endeavor, with perseverance in trials, may secure a success, and these Southern lands may yet become thronged with herds of all sorts in the fields, even as now in the forests, but with better breeds.

Here in the extreme South of our land, and in this Station, is perhaps the best place to work out this problem, and we will endeavor to do justice to the matter.

On October 27, 1887, a plat of ground on the College campus was sown with timothy seed brought from Michigan. It was sown in drills, eastward and westward, on exhausted sandy soil. The object of the drills was for easy weeding. It came up well in ten days, though there had been but little rain. In four weeks the drills looked beautiful and of a delicate grass-green color. In six weeks the growth had not proved satisfactory, there having been a dry spell. Then a portion was fertilized with the Sopchoppy phosphates, and another with the Armour fertilizer (blood and bone), while still another was treated with air-slacked lime, properly applied. In the first two cases the improvement was very marked. The timothy presented a luxuriant appearance of deep green color. That treated with the lime was also benefited, but in less degree. The portion of the plat not fertilized has its grass much less advanced, and, as appears, the stand is less good. The blades are slender, pale and yellowish in appearance.

About three weeks ago the fertilized grass was cropped off, when about six inches high. It stooled somewhat, and now, April 6, the drills fertilized by the Sopchoppy and Armour fertilizers look rank and thrifty. The drills with the lime treatment are fair in appearance, while those left to the resources of nature simply are unpromising in looks. Still these present no appearance of decay.

Future bulletins will afford records of the continued experiments with timothy, and these with additional tests.

It should be remarked that the timothy plat was left to the mercy of the season, on a rather dry soil, while there was lack of rain for several weeks, during which the growth was only arrested, but no decay followed.

KENTUCKY BLUEGRASS. (*Poa Compressa.*)

A plat of ground on the College campus, which had been put to use of the Experiment Station, was sown with Kentucky bluegrass, in drills. The seed was from Michigan, and the question of naturalization from so distant a Northern locality is thus tested as well. The ground is the same as that sown to timothy, just treated of, and the same treatment was given as in that. In this the appearance of the growing grass is obscured by the result of an accident, of impurity of seed. Timothy and redtop seed were in the mixture. Still we have here a test of the mixed grasses, and so in this have somewhat of compensation for the mischief of the fouling of the seed. These grasses appear fine in the fertilized drills, just as in the case of timothy alone; but in the unfertilized drills the grasses are dwarfed.

The seed was sown at the same time as the other (timothy), and so had the same experience as to rain and weather. The timothy here mingled among the bluegrass is more luxuriant than the latter, and has put forward a greater development of both root and stalk.

The matter of interest in experimenting with bluegrass in Florida is to prove concerning its perennial character. Even in the North it comes up delicately from the seed, and the stalk dies down early in the season. Our test thereof thus is not completed, this being the first year of its growth. But so far it certainly looks well. It has the same deep green color and slenderness of blades here as in the North, and thus its characteristics are maintained.

TEXAS BLUEGRASS. (*Poa Arachnifera.*)

The experiment work of this Station has not been confined to the College grounds. Eligible neighboring localities are being utilized, great as are our home advantages. One instance of this extra work is here reported in a brief given by Mr. J. C. McFarlane, whose place lies close to the College grounds, and who was in charge of this grass experiment. His report is here given:

"I procured the sets of the Texas bluegrass from W. P. Horn, of McClenny, Fla., and planted them in rows eighteen inches apart, and settings eight to twelve inches distant. In one year the whole plat was densely covered. The planting was done in the latter part of November, and in the last of the following March I cut the first seed that ripened. After saving the seed I let the grass take its chances with the native grasses. The crabgrass prevailed and covered the bluegrass. In the last of June I cut the grass for hay. The bluegrass was thick in the bottom, and together the product was one and a half tons to the acre. The crabgrass again prevailed and I cut a second crop of one ton to the acre. As soon as the cool weather came on the bluegrass again stood well and afforded a good lot of seed. I pastured it severely then, and the horses, in particular, seemed to be excessively fond of it. They appeared disposed to take it up by the roots. But on resting again it recovered, and now (March 30) looks well again, and will soon produce a crop of seed.

"The ground is not shaded, is newly cleared, lies level, and was recovered from pine and oak woods. It is very sandy. The soil had a light dressing with stable manure the year before putting in the grass, when cabbages had been raised upon it. Otherwise no fertilizer was employed. I am certain that the Texas bluegrass will do well in Florida in any reasonably good soil, and will afford our best winter pasturage."

The following is from J. N. Whitner, Professor of Agriculture and Superintendent of the College farm, and speaks in still stronger terms for this Texas grass:

FLORIDA AGRICULTURAL COLLEGE FARM,
March 29, 1888.

TEXAS BLUEGRASS. (*Poa Arichnifera.*)

The widespread interest which this grass has awakened among farmers and stockmen, the favorable reports from those in this State who have to some extent been experimenting with it, and the probability of its coming into general use for winter pastures, make it desirable to learn something of its early history, name, etc.

In the report of the Botanist of the United States Department of Agriculture, of 1881 and '82, appears this statement: "The *Poa Arichnifera,* locally called Texas bluegrass, has been known for many years as one of the native grasses of Texas, and during the past six years has been made the subject of some extended experiments, chiefly by Mr. Geo. H. Hogan, of Ellis county, Texas. The species was first described by Dr. John Torry, in the report of Captain Marcy's exploration of the Red River of Louisiana, as having been found on the headwaters of the Trinity, and named *Poa Arichnifera,** from the profuse webby hairs produced about the flowers, although this is found to be a variable character, probably depending upon the amount of shade and exposure to which the grass is subject."

"Several years ago," continues the Botanist, "Mr. Hogan sent specimens of the grass to this Department, which were examined and determined by the Botanist, and as it was shown to be a relative of the Kentucky bluegrass, *Poa Pratensis,* Mr. Hogan adopted for his species the name of Texas bluegrass."

Mr. Hogan's estimate of his grass, after trying it for five years, appears in the following extract of a letter to the Department, contained in the same report:

"I call it Texas bluegrass, and if it were possible to patent it I would not give it for all the mineral wealth of Texas. * * * I claim for it all, and more in Texas, than is awarded to the *Poa Pra-*

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* From the Greek words *arachnion,* a spider's web, and *fero,* to bear, to produce.

tensis in Kentucky. It blooms here the last of March, and ripens its seed by the 15th of April. Stock of all kinds and even poultry seem to prefer it to wheat, rye or anything else grown in the winter. It seems to have all the characteristics of the *Poa Pratensis*, only it is larger and therefore affords more grazing. I have known it to grow ten inches in ten days. The coldest winters do not even nip it, and although it dies down during the summer, it springs up as soon as the first rains fall in September, and grows all winter. I have known it for five years, and have never been able to find a fault in it. I have never cut it for hay. Why should a man want hay when he can have green grass to feed on?"

It was deemed highly important to subject the Texas bluegrass to full experimental tests, for the following reasons:

First, Because it is a *winter* grass, of which we are in gread need.

Second, It had been *successfully* grown in Sumter county, Georgia, on similar sandy land to ours, since 1885.

Third, Its power of resisting the damaging effects of severe drouths, due to its habit of rooting deep.

And last, Because as a perennial it would rank the small grains, rye, oats, etc., which require annual sowings.

Learning that sets—much to be preferred to seeds—could be obtained of Captain Carlos Reese, of Marion, Ala., cheaper than elsewhere, and being personally acquainted with customers of his who had dealt with him to their entire satisfaction, I remitted the money for 2,000 sets for the College farm, and received from the old gentleman, on the 15th day of November, 3,800 fine, vigorous plants, in excellent condition. The 1,800 extra sets were thrown in as a sort of tribute to friendship and for "good measure."

The plot of ground selected for the experiment was a piece of nearly level, thin sandy land, on the western slope of a hill, with southern and eastern exposure. Subsoil a kind of pipe clay.

The sets were planted on the 16th of November, in rows two feet apart, and eight inches in the row. The ground was exceedingly dry, and had been so the whole fall; no rain of consequence had fallen for months. This was why the planting had not taken place six weeks before—waiting for rain. But it had to be dispensed with at last, or abandon the experiment altogether for the season. It became necessary, therefore, to use water very freely from a well near by. Before doing so, however, cotton seed meal at the rate of 450 lbs. to the acre, with double that quantity of gypsum, previously mixed, had been distributed along the drill, and well incorporated with the soil, by passing the garden plow several times along the rows. The sets were then planted by line, and only moderately watered, on account of the exhaustion of the well's supply. About the third or fourth day from the planting, the drouth continuing, an effort was made to water the sets by carrying the water quite a distance from a brook. But this did not amount to much, and it is therefore worthy of special note that during the interval of over two weeks from this insufficient watering to the first shower, the plants maintained their green foliage without even wilting, which certainly favors the drouth resisting claim. There was no progress in growth observed during this trying period. Very soon after the rain the plants made a very perceptible start, and other showers succeeding, although sometimes followed by weather cold enough for ice, they have continued to grow with increasing vigor up to the present time.

The plot received two plowings with a garden (hand) plow, on December the 8th and again January the 10th. The rapid development of stolens or shoots prevénted further work. These stolons multiply very fast; the shoots are popping up all over the space between the rows, and it cannot be long before the grass secures solid possession of the entire area. The flowers began to appear the first week in March, and the indications are that the seeds will probably mature by the 10th of April, perhaps a little earlier.

The experiment so far is most promising and encouraging. The grass at this writing (March 29) is about fifteen inches high, of a dark blue color, erect and uniform in size, and presents on the whole an appearance of rural loveliness that charms every beholder.

If this grass should succeed, and becomes distributed throughout the State, as is most likely, we will be sure of green pastures all the year round. With the Bermuda for summer, and the bluegrass for winter use, what more can we wish?

Another season I propose by experiment to test the relative '*domain strength*' of the Bermuda and Texas bluegrass, by planting sets of each in alternate rows. If, after the fight, they shall make an amicable arrangement by which each in his turn shall rule six months at a time, we can then have a pasture which we may with propriety designate "ALL THE YEAR ROUND."

J. N. WHITNER,
Prof. of Agriculture and Superintendent of the College Farm.

REDTOP. (*Agrostis Vulgarus.*)

This common grass of the Northern meadows and pastures is somewhat less esteemed for excellence of quality than for its persistency of growth. It is a *stand-by* grass. But whatever its inferiority may be among the best of Northern grasses, it will be a welcome resident of Florida if it shall prove to be disposed to stay with us. Trial of this is to be made in this Station. Seed bought at a Michigan seed store was sown on a small plot on the College ground. It was sown in drills, as was the timothy and other grasses put to experiment, on old exhausted ground, with intention of after treatment with fertilizers, in part, and some left to the exhausted soil, thus to prove its life force, and its capability of making a reliable pasture and forage grass on the poorer Florida lands. Some of it was treated with the same fertilizers and in the same manner as was done for the timothy having been sown at the same time, and on the same quality of soil This grass has proved equally hardy in growth during the dry spell. It is progressing finely now (April 6), and will be cared for properly, so that future bulletins may record the results.

RED CLOVER. (*Trifolium Pratense.*)

Here now again the object is to ascertain whether the almost universal sentiment, that the standard pasture and forage plants of the Northern States will not do well in Florida, is *true* or *not*. It would seem to be true, if we were to note the fact simply that we do not see these grasses grown here to any extent. Is the difficulty—if there be a difficulty—that the clover is naturally a *biennial* plant, and being sown here, where the season is so long of high temperature, it is disposed to take on the habit of the *annuals*—mature its seed and die? This question must have attention.

Some declare that the summers in Florida are too hot for clover. But, then, the question arises as to why equally hot days do not kill the clover during hot seasons in the North?

Others assert that it is the prevalence of sand in our soils that is detrimental to clover raising. But, then, we do not see the clover on our Florida clay lands, of which we have considerable. Others, again, say that the absence of lime in the soil is the cause of our failure. But in this it may again be answered that we have much limestone land in Florida also, and yet we do not see the clover on these lands.

The obvious truth is that the secret of the successful raising of clover in this country is yet unknown, and hence experiment stations, properly conducted, will, for purposes of solutions of such questions, be of immense service to the State. We will see, on full trial, what can be done for clover culture here. The plant is now growing on our Station grounds, and so far the proceedings in the treatment of the clover have been varied and have been conducted with care. Several plots have been sown with seed from Michigan, which was pronounced to be good seed. It was sown in drills, on exhausted soil, on the 28th of October, 1887, and came up moderately well. It was sown thin in drills, and the stand was not regular. Still the appearance of the young clover was satisfactory, although there was not sufficient rain for some weeks to wet the soil through. In the latter part of December fertilizers of the Sopchoppy phosphates, Armour fertilizer, vegetable compost and air-slacked lime were applied to different drills of the clover. The results were obvious. The phosphates produced quite the best result, and the lime came in next. The bone and blood fertilizer and the plant compost were less beneficial. But after all, the experiment was hardly a fair one, for during the dry spell the sand was drifted over most of the clover, and in its removal perhaps an equal care was not afforded. Nevertheless, all the clover is living except what the ground moles destroyed, and most of it is doing reasonably well. A good rain had fallen in the early part of March, and the clover all became revived in a most notable manner. Soon after it was cropped off. Then it stooled out somewhat and seemed to rise more vigorously.

No doubt but we will have opportunity to test clover pretty well on our grounds, and it shall have proper attention and be reported on in future bulletins.

WHITE CLOVER. (*Trifolium Repens.*)

The experiments with this variety were exactly like those of the red, and the results were much the same, except that in this the sand drift did more damage, owing, perhaps, to its more procumbent growth. Its setting is less even, and its growth is slightly less. The lime treatment seemed also to do equally more for this clover than the other fertilizers except the phosphate, which was still better.

YELLOW CLOVER. (*Trifolium Procumbens.*)

Only a small patch was sown with seed of this clover, owing to lack of seed. Some settings were put in, and these have done well. The seed did not come up well, which seems odd, because it is so vigorous in the North, where it becomes such a nuisance. The sand drift almost ruined the stand from the seed; yet we have sufficient to test the persistency of this species. Still it probably will not do much except for close pasturing, since even in the North it never rises high, while as a creeper it is prodigious.

The clovers will certainly be a great boon for Florida if their successful culture can be attained. Especially is this true of the red clover as a pasture and forage plant. The white clover would be a great desideratum for Florida bee industry. Even now bees do well, and this clover resource for honey would very greatly enhance the product, while doubtless the quality of the honey would be greatly improved.

But when clover is estimated for its value for stock only one-half of its full importance is cited. As a fertilizer and source of plant food for other productions it has no equal now known. It has a great quantity of nitrogen in its stalk and leaf, while the heads are still more rich in this important element in plant food. The roots of the clover also run deep, and in decaying they let the air and carbonic gas into the soil abundantly. The turning under of a heavy stand of red clover when in full bloom is, in the North, regarded equal to a most liberal dressing with stable manure. What would this do for our Florida pine lands?

CRIMSON CLOVER. (*Trifolium Incarnatum.*)

This variety of clover, resembling the common red clover in all except its head, is a very excellent variety, hardy and prolific. We have a patch of it in our Station which is remarkable for the luxuriance of its growth. It is a native of Italy, and has long been cultivated in France and Southern Europe. By some it is called German clover, and this so because in that country it is so conspicuous.

This variety, so closely resembling the red clover in all except its elongated blossom or head, is by some regarded quite the equal of that as a pasture and forage plant. Should further experience prove this it will be a great thing for Florida, if—what now appears in our Station—its superior adaptation to sandy dry soil is maintained. Right by the side of other plants regarded hardy, this clover grows in great luxuriance, while round about it others suffered from drouth. The Japan clover, which is said to "grow with great luxuriance in the poorest soils, and retaining vitality in its roots in the severest drouths," has dwarfed right along side of this in a dry spell, while this has maintained its full vigor.

We have high hopes from this plant as a Florida pasture and hay plant.

JAPAN CLOVER. (*Lespedeza Striata.*)

This plant, which in appearance does not fill the description of it as given in the *American Farmer*, has failed also to prove persistency of growth. At least the stand of it, in our experimentation, is not satisfactory. Some stalks of it, however, are rank, and have grown taller and ranker than as described in the *Farmer*. Its flowers are axilary but pedunculous and in racemes. Its tripliate leaf is clover like, and in taste resembles the common white clover.

BERMUDA GRASS. (*Cynodon Dactylon.*)

It is quite unnecessary that the Bermuda grass should be tested in any experiment station, since it has already established for itself so good a reputation as a reliable summer grass, even in the dryest seasons. Where nothing else seems able to grow, there this good friend to the cattle kind is often found. Nor yet only for those, since all grass-eating animals will eat it with relish. Hogs thrive on it, and fowls eat it. If experimentation were of service it would seem to be needed to test the question as to where it will *not* grow if only the climate be mild. It will not endure freezing. Its seed is not required for propagation. Every joint of its stem is equal to a seed, and will grow even sometimes when left on the surface of the ground, for the first rain will sufficiently bury the joints to allow it to take root and grow.

We have a fine lawn of the Bermuda grass on the college campus. It was put in a year ago, from settings made of the chopped stems of old grass, and has now evenly spread, and is dressed by use of the lawn mower.

RUSSIAN VETCH—RUSSIAN SHEEP_FODDER. (*Vicia velosa.*)

The vetches are standard pasture plants in Northern Europe, where cattle, and particularly sheep, are fed largely upon it. But what it will do in Florida is yet problematical. We have some in experimentation. Some drills of it were seeded down on the 23d of February. It came up unevenly, but that which does stand looks well. In appearance it is like parsley or young carrots. We will take good care of it, and ascertain what it will do in acclimation here. Should it prove a success, it will come in good with the Bermuda grass—this latter as a *summer* grass and the other as a *winter* pasture.

ALFALFA—LUCERNE.

Much has been stated about trials made with this forage plant in Florida, and it affords one of the many instances when reports differ so widely as to be even almost the contrary. The question, however, is thus only as to its successful cultivation here. All admit it as a good article of food for cattle. We have made two trials. In the one we put it on poor old soil. Here it failed. In the other in rich soil, where it now grows pretty well. In another bulletin we may be able to report more concerning it.

GARDENING SECTION.

The gardening portion of this Station has not yet been brought to an extent that affords much of interest. A few tests have been made, however. Some in view of determining questions of exemptions of delicate plants from frosts in *varied localities* exposed in open field. Other trials were made to test the effect of frost in *same* locality with varied *exposures* and varied qualities of *soil*, while, as will appear below, some experiments were made for other objects still.

POTATOES. (*Solanum tuberosa.*)

A few varieties of potatoes were planted on the 6th of January. Among these were the Early Rose, Snow Flake, Beauty of Hebron and Chili Red. On the night of February 27th two patches in which were planted some of each of these varieties, one was nipped, and the other patch escaped—each planted with same varieties, and both patches in the same field. On the night of the 28th of February the plants of the patch nipped before were cut down to the ground, although the cold was no greater. The other patch escaped. The damaged portion had a southern exposure and the other a western. The soil in each was of a sandy loam. The damaged patch had a subsoil of clay; the other, of red and white sand. The first had a thin stratum of shaly sand rock overlying the clay; the other was all sand. The patches were only four rods apart, in the same field.

No potatoes planted here after the 28th of February, and such also as were planted before but still not put out above ground, were free from all damage, though a few slight frosts did occur thereafter.

The Early Rose plants had at the time of frost new tubers as large as hen's eggs.

President Holladay had potatoes planted alongside of the Station on the 28th of January, on new ground, on which he found tubers of equal size to those here cited, on the 6th of April, having grown thus to this size in thirty-eight days from planting.

ASPARAGUS. (*Asparagus officinalis.*)

A good sized bed of asparagus was planted from the seed, by Dr. Appell, on grounds adjoining the Floral section. The planting was in 1886. On the 20th of February, of this season, the plants of this bed were in good condition, and furnished good sized shoots for the table. At this time, 10th of April, the bed is thickly set with shoots of very vigorous growth. This and other trials prove that asparagus will do well in Florida.

CELERY. (*Apium graveoleus.*)

Our Station attests, with other trials, that celery does well here. Some of the most excellent celery that is seen anywhere is grown here. It has been furnished for the table ever since the 20th of February. The management of the plant was in no particulars different from what is practiced generally in its production.

CAULIFLOWER. (*Brassica oleracea.*)

This plant is also successfully raised here. and, like its kindred, cabbage, needs only a good, moist soil and proper culture to afford abundant products.

RHUBARB. (*Rheum.*)

The pie-plant has an uncertain history in Florida. The rhubarb family belongs to a *colder* latitude than Florida, and it has been doubted whether it can be successfully raised here. Dr. Appell, working in the Floral section, has experimented with settings of roots of rhubarb. He reports that he planted with care some twenty roots in different situations, as to moisture of the soil. Those that he planted in dry soil died the first year. Others planted in wet soil died out the same year after planting, also. But Mr. J. M. Earnest, who also works under inspection of this Station, though more distant, succeeded well with the culture of the plant. He, it is found, had set his rhubarb in clayey ground, and Dr. Appell had put his in a soil free of clay.

More experimentation is still required for determining the adaptation of rhubarb to our climate. Popular reports are not reliable. These generally do not afford any knowledge of the *conditions* under which trials are made.

CEREALS.

WHEAT. (*Triticum vulgare.*)

There were only two varieties of wheat sown in this Station this year—the Mediterranean and the Martin Amber. Both of these varieties were sown early in November, on old ground, on an elevated spot, with southern exposure, overlooking Alligator Lake, a body of water a mile or more across. The ground was fertilized by cotton-seed meal and gypsum, and the wheat grew most luxuriantly until ready to shoot, about the 10th of March, when both kinds were struck with rust, alike bad. The attack was so sudden that within three days the lower half of the blades were all of a deep orange color. In six days longer, when the heads appeared, the stems also were rough with rust, and the further development of the plants was arrested almost completely. Only a small proportion of the heads are in bloom.

No microscopic examination was made at the time to determine the variety of the rust, owing to other cares that at that time intervened.

It should be stated that, although this wheat was sown on elevated ground or hill-top, yet the ground was flat at the spot, and during a rain that fell at the time, the ground was continuously wet for a week, which drainage did not prevent. In the midst of this wet spell, when alternate sunshine appeared, the fungus was generated.

But this failure is set off by various other successful trials of wheat. Mr. J. M. Earnest, who works under inspection of this Station, has raised good crops of wheat for several years in Leon county. The Red Bearded variety has done well; also the Scotch Fife variety. Both kinds filled pretty well, and the berry was plump and heavy.

But, after all, it would be unreasonable to suppose that Florida, or any of the Gulf States, are ever to be wheat-growing States. This cereal belongs naturally to colder latitudes. Then, it is to be remembered, that Florida lands are too important for other uses than to be brought into competition with the vast wheat-raising countries.

RYE. (*Secale cereale.*)

Rye is a product raised in Florida with facility. It is generally sown for forage purposes and for turning under as a fertilizer; but the grain fills well here. We have been experimenting with rye to ascertain what it will do on recently recovered soil from swampy localities. It has proved in this one case amazingly fine. The stand is compact; average height, five feet ten; heads, six to seven inches long, and they are now filling nicely. It was sown in November.

Last season two acres had been sown on the college grounds, on exhausted soil, and without any fertilizer. The rye came up thin; that is, only a single stalk mostly came from a seed. It grew to the height of three to four feet, and headed out moderately well. The product of grain was not estimated. It was intended as a fodder experiment by those who had it in charge.

OATS. (*Avena sativa.*)

All varieties of oats seem to do well here. Experimentation with this grain has not been extensive, but it has proven that the soil and climate do well for oats.

CORN. (*Zea mays.*)

The great maize family may be said to have its natural habitat in Florida and the West Indies. While yet experience has proven that many of its varieties are readily acclimated to greatly varied climates. Experimentation has been conducted as yet with only a few sorts of corn and maize. All know the facility with which crossings, or hybrids, are formed. All know how difficult it is to maintain permanent varieties. Some fifteen varieties of maize are now in hand at this station, and it is expected that something of interest will follow in future bulletins. The natural enemies to corn and its kindred will be properly studied.

Kaffir corn and several other varieties of fodder corn are receiving attention. Sorghum, sugar cane, broom corn and sweet corn are growing well in this Station.

BUCKWHEAT. (*Fagopyrum esculentum.*)

Buckwheat has been supposed to be unadapted to our climate, but we have a plot of it now beautifully in bloom. It was sown on exhausted soil on the 1st of March, and has a good stand. It affords abundant promise of a good yield.

HORTICULTURAL SECTION.

Not many varieties of fruit trees have yet been subjected to treatment in this Station, as our work is yet in its incipiency. Still it is expected that future bulletins this year may nevertheless prove of interest.

ORANGE TREES. (*Citrus auranteum.*)

Forty orange trees, of divers sorts, are in cultivation in this Station. Several trees of the *citrus trifoliata*, now three years old, have bloomed, and are setting with fruit now. This variety is a hardy one, and doubtless would be suited for hedges. Its fruit is small, but the tree is quite interesting for its appearance.

The diseases of the citrus family will be carefully studied at this Station, and results reported. No opportunity has yet been had to do much for the great industry of orange growing; but this must receive special attention; particularly must care be afforded in the study of the noxious insects that injure the citrus family.

APPLE TREES. (*Pyrus malus.*)

Florida is reported to be no place for producing apples, and this would seem to be true, if we take appearances for judgment. Not many apple orchards are to be found in Florida. A few homes have one or more trees, the object of them being more for curiosity than fruit.

Of late years some success has been achieved by budding upon the stalk of the pear. This would show that the roots of the trees determine the conditions of success in growing the trees. But exceptions certainly obtain, if a rule is to be recognized, that the apple does not do well in Florida. In Wakulla county Mr. Ashmore has a number of apple trees in his orchard that look thrifty, and have borne well for a number of years.

The following is from a letter to the Director from Mr. J. M. Earnest, of Chaires, Leon County: "For a number of years I tried to raise apples on their own stalks, but had no success. In 1883 I budded the red Astrachan apple on the LeConte pear stalk. In 1884 I got some fine fruit from these, which gave me encouragement, and I went extensively into the apple business. I now have thirty varieties of apple trees growing on the LeConte stalk, all of which are doing well. By these means we can raise as good apples in Florida as there can be grown in Virginia or Pennsylvania."

The apple trees growing on their own roots appear here like those trees in the "apple belt" that are neglected. They become bushy, rough and stunted. The outer bark is loose and shaggy, and is covered by lichen and moss. The twigs and branches are slender, and inclined to grow vertical, like the Lombardy poplar. No doubt much of this appearance of the trees is caused by neglect. Our Station has not been in operation long enough to afford opportunity for any considerable attention to apple culture.

PEARS. (*Pyrus communis.*)

What has been stated of lack of time for operations in this new Station, when treating of oranges and apples, is applicable also concerning pears, and, indeed, most varieties of trees and shrubs. We have not yet had *time* for the work. Still we have some pear trees under care. The LeConte does well, and so do divers other varieties. This may be said: that pears naturally do much better in Florida than apples. Yet occasionally blight among pear trees is to be seen. The Director visited a grove of LeConte pears at Ocala, that were planted on a limestone ridge where the soil was not over a foot in depth over the rock, that was blighted very badly. Seldom a tree of this grove was exempt from the disease. This matter must be investigated. The trees in this case had been set six years before, and had grown beautifully up to the present year, and had borne some fruit. This year they are all dying.

PLUMS. (*Prunus.*)

This is a grand State for raising plums. The forests are full of wild plums, and buds and grafts from cultured trees set upon stalks of native plums do exceedingly well. So do peach grafts and buds. The Kelsey plum in particular does finely on the native plum stalk. We have such in experiment. President Holladay, of the Agricultural College, has a dozen or more native stalks grafted with the Kelsey that have shoots thirty inches in length, produced in seven weeks from time of grafting! Other examples in the Station afford similar results. The fruit produced is very fine and luscious. The color thereof is yellow, with reddish tint.

PEACHES. (*Amygdalis Persica.*)

No country perhaps is better adapted to peach culture than Florida. The tree is a native of the coasts of the Persian Gulf, from whence came, directly or indirectly, all in Europe and America. The coast of the Mexican Gulf affords a similarity of conditions and climate, and although the peach and its kindred are now naturalized in most countries, yet it is questionable whether the fruit is equal anywhere to what it is in Persia and Florida. Certain it is that earlier varieties grow here than what are found elsewhere in America. At this time (April 11th) color is coming on the fruits in several varieties that have attained full size, and are now ripening. These are the Peen-To and the Honey peach. Our Station affords good specimens of these. One drawback with the Peen-To is that the trees bloom too early here in Northern Florida to be certain not to be affected occasionally by late frosts. But we have reasonable hope to remedy this by modification in treatment.

CHESTNUTS. (*Castanea.*)

Several varieties of chestnut trees have been experimented with here. The Japan chestnut tree thrives with great luxuriance. One tree, raised from the seed, in four years has borne fruit. This is of unusually large size. The tree itself appears very elegant, and makes an ornamental tree much to be desired. The Italian or Spanish chesnut trees have done less well with us.

CAMPHOR TREE. (*Laurus camphora.*)

We have several small camphor trees in the Station that are doing well. They seem not to be affected by the degree of frosts that we have here.

PALMETTO.

Experimenting with the cabbage palmetto has been practiced to determine the measure of success in forcing them out of their habitat. The first planting, which was done in the spring last year, when four trees, with stems five feet high, were taken from the banks of St. Marks River, and set in front of the college campus. Three of the four died. One is still living. This spring eight more have been taken from the same locality, and were planted on the college campus and adjacent grounds. This time care was taken to set trees on dry, sandy soil that were taken from the most elevated and dryest localities found where obtained, and then in setting them care was taken to insure moisture sufficient by placing a basin-bed of clay at the bottom of the pit where set. Those trees so treated are living now, though they seem not yet disposed to grow.

Other trees, taken from low and wet places, were set in similar situations on grounds near the Station. These do finely.

The blue palmetto grows well with us after transplanting. But the saw-palmetto does not do so well. Still this variety proves capable of being transplanted.

MYRTLES.

Cape myrtles and wax myrtles bear transplanting. A dozen trees are doing finely on the Station grounds.

JESSAMINE.

The wild yellow jessamine (*gelseminum sempervivum*), taken from the woods and set about arbors on our grounds, are doing finely. They were taken up during blooming, and they continued to bloom right along.

CEDAR.

Young cedars, taken from the forests, have been set on the Station grounds, and about one-half of them did well. Pines set at the same time did less well. Arbor vitæs do well.

YUCCA.

Two species of Yucca—the "*bear-grass*" and "*Spanish-dagger*"—have been transplanted, and do well on the campus.

MAGNOLIAS.

Several dozen trees, large and small, have been set on our grounds. They were taken from the forests. About one-half of them have done well, of the small—three to four feet high—and about one in four or five, of large trees—four to five inches in diameter—have lived.

HOLLY.

Wild holly trees from the forests, set upon our grounds, have done well.

OAKS.

Live oaks and water oaks have been transplanted from the forests to our campus. The trees are of good size—four inches in diameter—and all have lived and grown well.

PECANS.

Pecan trees from the nursery, and also from the forests, set upon our grounds, do well.

FLORAL SECTION.

Experimentation with flowers has also been provided for in our Station, and we have many thousands of flowering plants from all sections of the world now in successful cultivation. Most of these are hardy enough for out-door cultivation. But an extensive conservatory and propagating house has been provided. With these provisions an opportunity is afforded to test the hardiness of plants by exposures, while always their duplicates are kept under protection.

The following synopsis must answer for the present bulletin to indicate the results of experimentation. Dr. Appell has charge of this section:

ROSES.

Several hundred varieties, from seeds and cuttings, are doing well. This climate brings to perfection many varieties that do less well in colder climates. Some of the most delicate Chinese and Japanese roses are now blooming finely. During the time of the frosts of February the blooming was arrested, but the plants did not suffer materially.

CAMELLIAS.

A great variety of the Japonica species, from the deepest crimson to pure white, endure all the cold occurring here, without detriment.

CACTUS.

Many varieties of cactus are exposed here to cold and heat, drouth and wet, to prove their power of endurance. It is remarkable what life persistency these plants have. Some varieties have lain out for days in the sun heat, out of the ground, and seemed disposed to accommodate themselves to the exposure. Numerous species of cactus grow wild here, and their flowers are exquisite.

LILIES.

Improvements in the lilies and amaryllis are being attempted. A great variety are treated in this floral section.

TOBACCO.

There is a large variety of tobacco, of Spanish or Cuba kinds, as also other important ones, now planted on the grounds of this Station that will be attended to with discriminating care, and will be reported on in subsequent bulletins.

ANALYSES.

The analysis of the grounds of this Station, as also the analysis of other materials, has unavoidably failed of report in this bulletin, and will appear in the next.

NO. 2.

BULLETIN

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STATE AGRICULTURAL COLLEGE,

LAKE CITY, FLA.

MAY AND JUNE, 1888.

J. KOST, M. D., LL, D. Director.

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AGRICULTURE.

GRASSES.

In Bulletin No. 1 it was stated that the more important grasses of Northern meadows and fields were put on trial and experimentation for the object of ascertaining their possible adaptation to our soil and climate. These were mainly timothy, red-top, Kentucky blue-grass, orchard grass and the clovers. In that number it was reported that a moderately good success had then (in April) been attained. One month's additional experience has proven additional success. The drouth through which these grasses here put in had passed afforded a good test, one going far in affording a good judgment concerning the practicability of the growing of these grasses in our State. The drouth was followed by seasonable rains, and all these grasses now look well and occasion much admiration. Especially is this the case with the patches that had been watered with the sprinkler, but even those others that had been intentionally left without are of encouraging appearance, though the stand is not really good.

The Kentucky blue-grass and red-top had been mostly left to run to seed, and are now developing seed. The clover had been cropped mostly for the purpose of testing such treatment. It also looks well.

Later (that is March) sowing of seeds of these grasses has not done well. The drouth struck them while the plants were yet delicate, and with short roots that did not extend below the dried surface, and the consequence was that all dried up.

The timothy is now shooting stems for seed, and looks exceedingly interesting here in Florida. The red clover, as stated, has been mostly cropped, but where not so treated it is headed out.

We cannot, of course, form any estimate of the weight of hay that these grasses will produce in Florida, but all who see them are full of admiration. Another Bulletin may afford still more satisfaction. On the whole, if a single season could determine the matter, we might now pronounce it a success.

The orchard grass was sown broadcast, in a patch bordering a strip of woods. The margin next to the woods, though a little off.

looks well. The shade strikes this part of the plat in the afternoon. That portion continually exposed to the sun looks indifferent.

CRIMSON CLOVER. (*Trifolium incarnatum.*)

This plant was made the subject of noted remarks in Bulletin No. 1, and we are happy to report final success. The clover is now ripe with seed, and the common red clover (*Trifolium pratense*), as raised in the Northern States, never looked better than this new variety does here in our Station. Not only does our experimentation prove the adaptation of this clover to Florida, but reports from others we correspond with corroborate our estimate of its importance. We surely have now in Florida standard winter pasture grasses in this and the Texas blue-grass, while the Bermuda grass and divers others afford standard summer grasses. For hay crops both are equally reliable.

Our test of the crimson, or long-headed clover—Italian or German clover, as it is also called—has been very simple. We put it in well by sowing broadcast in November, and let it alone with simple protection by fence from intrusion. It came up well, had a close and even set, and has now matured in a prodigious crop of seed. This is not yet gathered and no estimate of the product, by measuring, has yet been had. It stands in height about 20 inches.

The Station can furnish *free* small quantities of seed to farmers who send postage for mailing it. Two to four cents will answer for all we can promise to send to each one sending this season. We will send as long as the seeds hold out. It should be sown just before the winter rains. We can also send, in the same way, small quantities of Texas blue-grass. But this is best put out by root sets, which, for short distances, can also be safely sent by mail. For root sets 5 to 10 cents postage will afford a good start thereof.

GARDEN SECTION.

The following report is from Dr. J. F. Appell, who has charge, of this section of our Station:

To Dr. J. Kost, Director:

SIR—I have the honor to present this report of the work in the department under my charge.

STRAWBERRIES.

Ten varieties of strawberries were tested during the season just closed, viz: Hoffman's Seedling, Noisette, Parry, Crimson Cluster, Crescent Seedling, Monarch of the West, May King, Triomph de Gand, Sharpless and Lenning's White.

Of these the Hoffman and Noisette have done the best, proving themselves to be particularly adapted to our climate and soil. They have produced more fruit than any of the others. The Hoffman gave the earliest fruit of all. The Noisette, coming into bearing later, produces very fine fruit abundantly and continues in bearing a long season. The plant is very vigorous, sometimes twenty inches across, and the foliage healthy. Fewer plants of this variety died during the recent drouth than of any other tried.

The Parry, Crimson Cluster and Sharpless produced the largest berries, but less abundantly.

Lenning's White is the only kind that has resulted in a complete failure.

The strawberry bed covers a space of 50x150 feet, containing 3,500 plants, two-thirds of which are Hoffman's, and has produced, up to May 19th, a few quarts less than 400, and they are still bearing freely. Most of the plants were set out as late as November, and many had to be re-planted, owing to the extreme drouth.

Thoroughly rotted stable manure was put under the plants when set, and before bearing, in February, the soil around each plant was removed with the hand and fertilized with "Blood and Bone" and Sulphate of Potash, in the proportion of one quart of the latter to a peck of the former.

With greater care in weeding and keeping the runners from the new plant (for it is best to make new beds each year), a considerably larger yield can be obtained.

The land on which these strawberries grew is reclaimed land from the border of a swamp, raised by placing 2½ feet of sand into an excavation and replacing the muck on the surface.

ONION. (*Allium cepa*).

This esculent, universally and successfully cultivated in all civilized countries, should be produced more successfully in Florida. I find that an erroneous impression prevails to a considerable extent throughout this part of the country, that perfect onions cannot be raised from the seed. To prove the contrary, to ascertain the proper soils, seasons, varieties and fertilizers best adapted to their perfect development and success, is the object of the experiments undertaken in this department.

Knowing that the finest and largest onions have been produced in warm countries, and that seed of these varieties is imported from countries bordering on the Mediterranean, the experiments have been directed to these kinds rather than those originating in cooler latitudes.

A deep, sandy loam, perfectly level, was chosen, free from roots and extraneous matter, and containing a large amount of vegetable matter, supplemented with fertilizers containing a large percentage of the leading plant food—ammonia, phosphoric acid and potash. The present experiments were conducted on land raised by putting sand under muck thrown up from the lake border, and sweetened by turning under two crops of cow peas, the plot employed being 2¾ feet above the ordinary level of the water in the lake.

The onion being a shallow-rooted bulb, requires considerable moisture, but the land must be well drained. A fine crop cannot be had from soggy land.

The onion seed loses its germinating power sooner, perhaps, than any other vegetable seed. This I judge to be one of the main reasons why they have not been relied upon, and why enormous quantities of "sets," or small onions, are annually purchased from Northern seedsmen.

The seed sown in hot weather must be shaded from the rays of the burning sun, for, however fresh the seed may be, the young germ will otherwise be destroyed, especially if moisture is deficient. We have sufficient evidence that seed grown in the South, properly matured and kept free from moisture, is reliable. To corroborate this statement, seed grown in this department will be reported on in future bulletins. Of the twenty varieties under experiment the following is the result up to date, May 19th:

"El Paso," "Giant Brown Rocca," sown September 20th and transplanted in November, have developed into large onions with big necks, not fully grown. Some of the El Paso weighed 1½ pounds.

"White Queen," sown November 24th, mostly matured; solid, flat, white bulb, from two to four inches in diameter. This is a perfect onion, without neck.

"Creole," "White Rocca," "Yellow Rocca," "Globe Madeira," "Bloomsdale Pearl," "Mammoth Silver Skin," "Mammoth Pompeii," sown November 25th. Most of these varieties have grown to large size, with long necks, and are still immature.

"White Bermuda," "Red Bermuda," "Teneriffe," sown January 3d. These have made small, firm, perfectly formed, and ripe bulbs.

"White Garganus," "White Nocera," "Maggiajola," "Barletta," sown January 19th. They are flat, white, and are developing rapidly into perfectly formed bulbs.

"Golden Globe," "Spanish King," planted January 19th, have not made much growth.

In future experiments seeds of each variety should be sown at the same time, so that the conditions will be similar. This was impossible the past season, owing to the difficulty of procuring seed of so many kinds. A few of the varieties may be similar under different names.

A consideration of the results thus far obtained seems to show that for rapid growth from seed, and the production of a perfect onion, the following varieties will prove a success in this latitude:

"White Queen," "White Bermuda," "Red Bermuda," "White Nocera," "Barletta," "White Garganus," "Maggiajola" and "Teneriffe."

A remarkable garlic, found in this country, and described in none of the seed and plant catalogues that I am aware of, has been cultivated during the past season and is now ripe. It is smaller than any garlic with which I am acquainted. It produces, at maturity, a dozen or more small bulblets on stems ten to fifteen inches high. The bottoms make one or two bulbs or "cloves," very solid and pearly white, keeping perfectly until the next season, in or out of the ground.

Although a garlic, it is free from the rank and pungent odor usually found in this species. Once planted, it comes each year from a bulb that may have been left in the ground, or from some of the bulblets which scatter when ripe. It produces at the rate of over 200 bushels to the acre.

MELONS.

There is the supposition, which is doubtless correct, that nature affords accommodations to seasons and latitudes. Thus, in latitudes approaching the pole, where the seasons are shorter, all annuals mature more speedily. This would argue that in Florida it requires more time to mature annual productions. In this Station a test was made with melons, but owing to the drouth that was experienced here this spring the test was not complete, because the growth of our plants was arrested for several weeks. Nevertheless, we produced from seed planted on new ground, in ninety days, ripened melons of good average size. This probably is not any noteworthy fact, however. Seeds of Hackensack cantaloupes were planted on the 24th of February that produced ripe melons on the 24th of May. These are of good size. Montreal Green Nutmeg Melon seeds, planted at the same date, required three days longer for maturity. Seed of Gray's Monarch—long-white—planted February 24, produced ripe melons of large size on the 24th of May. The following: Cuban Queen, Ice-Cream, Pride of Georgia, Seminole and Kolb Gem, planted at the same time, are a little later, but set very full of fruit.

EARLY CORN.

Seeds of Cory's Sweet Corn, planted on the 8th of February, produced roasting ears on the 15th of May. Those of the Hickock came in two days later. Those of the Stapler variety, planted at the same time, came in on the 20th of May.

We have plantings of date later than the time of the drouth that are doing finely, and will make quicker time.

It would seem desirable that Stations in Tennessee, Ohio, Michigan, Massachusetts and Maine would put in seed, say the 10th of June, as will be done in this Station, of sweet corn, and let the varieties be those above named. If reports are made of time that the roasting ears are fairly in season it may afford some satisfaction, if the character of the season be noted also

TERRACING AND DRAINAGE.

In the floral section of our Station we have two and three-fourths acres of ground that has been recovered by Dr. Appell from the domain of Lake DeSoto. In doing this the object, in experimentation, was not simply the recovery of land suitable for gardening purposes, that had for ages, perhaps, been under water, but the object also was to determine the extent of interstinal attraction of moisture that can be obtained by artificial means. What the method of sub-irrigation secures was here purposed to be realized by the contiguity of the lake.

It is not expected that the costliness of the proceeding will admit, here in Florida, where good lands are comparatively cheap, of this mode of improvement for general uses of land; but for smaller tracts, important for gardening and experimental purposes, it is justifiable, and the results of our work attest this in the most notable way.

The proceeding was by first raising the muck, at time of very low water, with spade, in parallel trench excavation, successively, of a few feet in width, the muck being deposited alongside on the opposite position from that where the work was approached. A sand bank of several feet sloping elevation was utilized in depositing from cars on tramway into the trenches, a layer of clean sand to height of 2½ feet above the common water level. This is the transmitting medium of water elevation by capillary action or interstinal absorption, which the clean sand afforded. The sand thus deposited was then overlaid by a return of the muck to a depth of 8 inches, which was to do the functions of the soil when properly handled and prepared afterwards.

It is easy to apprehend how successive parallel trenches were continued and filled by sand below and muck above until a wide terrace was thus made. The terrace was made flat of surface, the object being to regulate the moisture, the depth of the sand determining the extent and constancy thereof. The terrace is surrounded on the outer margin by a ditch to prevent overflow frcm landward.

Lake DeSoto has no outlet at moderate stages of water. The outlet at flood stages is wide, hence the elevation of three feet keeps the terrace in good condition.

Now the facts concerning DeSoto Lake are that no considerable displacement of the important fertilizing salts has occurred at any modern time, owing to the insular state of the water, and hence the muck is rich, flood time alone affecting it. In all similar lakes in Florida—and there are many—this principle of terrace construction will prove of eminent avail. This terrace keeps the proper moisture for plant production in gardening, and the most extreme drouths do not affect it, as the moisture is transmitted by the clean sand below, its functions (those of the sand) being very different from the silt sub-deposits common to lakes.

The after treatment Dr. Appell gave to the super-deposit of the muck was, after cleaning it of lumps, etc., by subjecting it in winter months to the growth of a stand of rye. At the first of April the rye, which was very rank, was turned under, and a planting of cow peas was made. When the latter was properly matured for perfection in nitrogenous matter—when the young bean of first or earliest growth had attained full size—the cow peas were also turned under, and the terrace was thus left to rest one month. This, in the first constructed terrace, was two years ago, and last year there had been a test of results which proved a most wonderful success. The present year is, if possible, still more promising of results. A succession of crops of divers kinds has been put in, and all have proven most satisfactory. In another section of this Bulletin will appear something of these crops.

Time alone can tell the significance of this principle of terracing on the borders of the numerous lakes of our State. The trenching or draining from landward is never to be neglected, as these terraces do not need the surface watering from overflows, and these cannot but do damage. The rainfall thereupon, however, is not commonly injurious, owing to the porous character of the deposits. In a few minutes after rains the surface of the terrace, although so flat, is in good condition again.

VETERINARY AND PHYSIOLOGICAL SECTION.

The following is such part of the report of Professor Maxwell as can have space in this number of the Bulletin:

"After appointment by Dr. Kost, Director of the Experiment Station, to investigate the causes and nature of the diseases of domesticated animals, I immediately entered upon the discharge of my duties.

"On the 24th of April I was notified of the death of a cow belonging to Captain J. F. Baya, of Lake City. Going at once I found a large red cow, of the Shorthorn and Devon cross, that had been dead about 12 hours. From her fullness of flesh it was manifested that her disease had been acute in character and of short duration, unattended with much waste of tissue. The history of the case showed that she had been sick about a week, but the description of her symptoms was not sufficient to warrant a diagnosis. The *post mortem* examination revealed inflammation of both lungs, which had passed through all the stages to gangrene, and as all the other viscera were in a normal condition, I felt no hestation in determining that acute Sporadic Pneumonia was the cause of death.

"May 7th I was called to a sick calf belonging to Mr. Potsdamer, of Lake City. It was 13 months old, and had been sick since November last—6 months—with what is locally called "Salt-sick."

"The calf was extremely emaciated, and was unable to stand. His ears hung down, his eyes were closed and weeping, and tremors occasionally affected his body, especially the head. The temperature was 98°.

"It was evident that he was dying, and I hastened preparations to examine him immediately. Before arrangements could be completed he died, but before *post mortem* changes had taken place, and while it was yet warm, I performed an autopsy.

"As I have said, there was extreme emaciation. There was very little adipose tissue, but what there was was of a bright yellow color, and the wasted muscles were pale and bloodless.

"Of the internal organs the thoracic viscera appeared normal, but a decidedly changed aspect was presented upon examination of the abdominal organs. The stomachs and bowels, except the large intestines, were almost empty. The latter were impacted with hardened fœces. Their mucous lining was extensively inflamed, with erosions within the true stomach. The liver was much larger than natural, of a pinkish yellow color throughout, resembling the human liver in yellow fever. So altered was the liver that an experienced butcher, to whom I exhibited a portion, was incredulous about its being liver. The gall bladder was distended with dark viscid bile. The spleen was atrophied, externally of a light gray color, and shrivelled like a hand that had been held in hot water. Internally it was very dark and disorganized, with vertical bands of organized tissue connecting the external membranes. The kidneys were enlarged, and engorged with dark blood. The urine bladder was distended with dark red urine, resembling in appearance to the eye, and under the microscope, that which is found in cases of miasmatic hæmaturia. The blood was very thin, and destitute of clots, except a small, firm one in the left ventricle of the heart.

"In all respects, except in the size of the spleen, this case presented the characteristics which are described by Drs. Salmon, Ditmers and others as belonging to that infectious disease which prevails from the larger part of Virginia along the Atlantic coast to Florida, and thence along the Gulf to Texas, called Southern Cattle Fever. I regret that I was not prepared to make such microscopic inspections, cultures, etc., as the importance of the subject demands.

"On the 20th of May I was called to see another cow belonging to Captain Baya, to which, as its suffering seemed to be from intestinal irritation, a brisk saline purgative was administered, with relief. The next day (21st) Captain Baya sent for me again, this time to see a cow and a young steer which were suddenly taken ill.

"The cow was thought to be well at noon, but soon after was taken violently sick, and at the time of my visit, at 4 p. m., was dying. In a few moments she died, and I opened her immediately. Her paunch was enormously distended with unmasticated food and gas, and her manifold was impacted with about equal quantities of finely chewed grass, etc., and *sand*, which offered an obstacle to the passage through the organ. Manifestly the cause of death was acute indigestion from the aforesaid impaction and obstruction. The steer was not so sick, and free catharsis, by a saline aperient, soon relieved it.

"GEORGE TROUP MAXWELL, M. D."

It is hoped that Dr. Maxwell; who has now undertaken the investigation of that singular cattle disease called "Salt-sick," and sometimes Texas Fever and cattle-plague, which seems to have prevailed slightly in special localities in our State, will not give it over until something more satisfactory shall be determined. It is fortunate that one so eminently qualified as the one having this position in our Station has been secured.

ENTOMOLOGICAL SECTION.

RED RUST ON WHEAT.

[BY WILLIAM H. ASHMEAD, ENTOMOLOGIST.]

The "rusts" that so generally attack the *Graminæ*, cereals, grasses, etc., are fungoid growths or parasitic forms of plant life, belonging to an extensive family, termed by botanists *Cœomaceæ*, and their germination and spread depend very materially upon atmospheric conditions. Sometimes they will lie dormant for years until such favorable atmospheric conditions exist—air at the proper temperature, moisture and sunshine—that cause them to spring forth into vigorous, luxuriant life, to the wonder of the observer and to the disaster of their hosts.

The "rust" mentioned by Dr. Kost, in "Bulletin No. 1 of the Experiment Station of Florida," page 17, attacking the Mediterranean and Martin Amber varieties of wheat grown on the experimental grounds at the State Agricultural College, Lake City, is of this nature, and proves (after a thorough microscopical examination of the samples of affected wheat sent me) to be nothing but a common species, quite prevalent, at times, on wheat, rye, oats and other grain crops in various sections of the North.

It is the "common red rust" of wheat (*Puccinia graminis*) now extensively distributed to all known portions of the world where this cereal grows.

It originates from "spores," or microscopical dust-like seeds that are carried from plant to plant, principally by the agency of the wind, and that ultimately find a *nidus* for their development and propagation in the cellular tissue of vegetable life, gaining access to this part of the plant through the *stomata* or breathing pores of the epidermis.

Wheat that has been attacked by red rust is easily recognized: The blades and stalks are usually the first to exhibit the parasite, presenting the appearance of being covered with little projecting points, sprinkled over with blotches of yellowish and reddish colored dust. These blotches spread rapidly to all portions of the plant, especially after wet weather, followed by a hot, dry spell, until finally they reach the wheat ears or heads, when the damage or loss to the grower is considerable.

A cross section made of a wheat blade affected by this rust, and placed under a powerful lens so the different cells composing the cellular tissue can be distinctly seen, shows the method of growth of this fungus and its injurious effects on the plant.

The *mycelii*, or the roots of the fungus, are plainly exhibited, extending in various directions through the cells, and drawing upon them for their growth and sustenance, thereby absorbing the vitality from the wheat. Upon each *mycelium* grows a globular head, swelling and increasing in size until segmentation takes place, and it is divided into thousands of little dust-like particles or grains, each grain being the seed of some future fungus.

It is the swelling or ripening process of the heads of the *mycelii* that rupture and burst through the epidermis, and produce the little projecting points on the blade and stalk, already mentioned, while the yellowish and reddish colored dust surrounding them is nothing but the spores or germs ejected from these heads on reaching maturity, and distributed about as is the pollen of flowers.

No satisfactory remedy is known for this fungus, and the only solution for the evil seems to be in introducing and growing varieties of cereals that will resist the attacks of these cryptogams.

THE PEACH CURCULIO. (*Conotrachelus nenuphar*, Herbst.)

(A little snout-beetle, stinging and laying its eggs in the green fruit, causing them to exude a gummy substance and fall to the ground.)

All during the month of April, the immature fruit on most of the peach trees at the State Agricultural College grounds, was stung by some insect, and dropped to the ground long before reaching maturity. Director, Dr. Kost, noticing this—and that it was of frequent occurrence all over our State—handed me specimens with instructions to investigate the trouble, and prepare a report on the subject for the next Bulletin.

This has been done, and below I give a description of the insect in its various stages, its method of injury, and practical hints and remedies for its destruction and prevention.

The little snout-beetle causing the injury, is identical with the "Plum Curculio" or "The Little Turk" attacking the plum at the North and West, and also attacking this and other fruits in Florida.

With us, it is unquestionably the most destructive enemy of the peach, the most difficult to contend with, and when unchecked in its depredations, occasions annually a loss amounting to hundreds of dollars.

The Beetle.—The insect that occasions this heavy loss is a small hard-shelled, black beetle, 20-100 of an inch long, having its head vertically elongated into a stout, strongly striate and punctate snout, at the tip of which is found a pincer-like mouth with which it punctures or cuts into the peach. Its back is roughened or corrugated, and marked with grayish colors, while on each wing-case or the hard, chitinous front wings—the hind wings being membraneous and folded beneath them—is a black, shining prominence, followed by a dull yellow band composed of yellow and white hairs. The legs are stout, blackish, while the thighs are much swollen and toothed beneath.

As soon as the young fruit is fully formed—which in Florida occurs early in April—the female curculio proceeds to lay her eggs. Alighting on the young fruit, she stings or punctures with her pincer-like jaws the tender immature fruit, forces her snout under the skin, puncturing and moving it about until, with its aid, a sufficiently deep and smooth cavity has been formed for the reception of her egg.

The Egg.—The egg, which she now proceeds to deposit in the hole just made, is 2-100 of an inch in length, of an oblong-oval shape, and pearly white color; after oviposition, turning about, with the aid of her snout, the egg is pushed to the bottom of the hole made for its reception. This important task performed, she makes, with her mandibles, a slight incision on one side of the cavity where the egg now lies, and the piece thus formed, is shoved forward, completely covering the egg, affording it protection from the hot sun, and hiding it from the preying eye of Proctotupid and other parasites.

The Larva.—In less than a week—the duration of the incubating period depending very materially upon the state of the weather, heat accelerating, cold retarding its development—the egg, so carefully deposited and protected, hatches, and there issues a soft, white, tiny grub or larva, which immediately begins to feed on the pulp of the green fruit, all the while boring and making its way to the stone or kernel.

It is during this period—while the grub is progressing towards the kernel, where it reaches its full growth—that the gummy exudation, so noticeable on green fruit, is formed.

The young grub arrives at maturity in the fallen peach, within four or five weeks; it is a maggot-shaped, footless, creamy white grub, and measures 35-100 of an inch in length. The head is light brown. Extending along each side of the body is a pale, glossy line, below this line a row of minute black hairs, while above or dorsally, there are two rows of hairs.

The Pupa.—The grub, having now reached its full growth, eats its way out of the decaying peach, and burys itself several inches in the earth, where it transforms into a pupa. During this stage it undergoes a marked change, and takes on the characteristic features of the future beetle. The legs, wings, snout, etc., of the *imago* being plainly revealed long before its final transformation.

Its existence in this pupa or chrysalis stage in its life's history seldom extends over a period of four or five weeks, when it transforms into a perfect beetle, makes its way to the surface of the earth, assumes its natural hue, and lives on different substances—leaves, bark, fruit, etc.—until cold weather, when it is compelled to hibernate for the winter under fallen *debris*, under logs, in crevices of bark, etc., coming forth again in spring to renew its depredations on young fruit as did its ancestors.

Preventive Measures and Remedies.—From a study of the life history of this beetle, as recorded above, it will be seen that much may be accomplished in preventing the increase of this destructive pest; and I believe firmly if the following preventive measures be carried out uniformly, judiciously and persistently from year to year, the results would be in diminishing annually their numbers, and ultimately almost entirely freeing our orchards from this most injurious species.

Removing Stung and Fallen Fruit.—All green fruit stung by the curculio, and exhibiting the gummy exudation, should be picked—they will never amount to anything if left on the tree—and, with the fallen fruit, should be gathered together and destroyed; not a single one containing the grub should be allowed to escape destruction, to produce a progeny for the following year.

Catching the Curculio.—Another preventive measure, and a well known one, is to jar and catch the curculios in nets or on sheets or cloth spread for the purpose beneath the tree, before they have had time to deposit eggs in the young fruit. The *modus operandi* is as follows: Take a large, white sheet, or, better, sail cloth, cut a circular hole out of the centre large enough to enclose the trunk of any sized tree, leaving a slit or opening to the outer edge of the cloth, so it can be laid out flat on the ground, surrounding the trunk of the tree.

The cloth now being properly spread, a sudden jar is given to the tree, or a succession of jars, and the curculios, as is their habit when suddenly alarmed, simulate death and fall to the ground, and are caught on the cloth. They can then be gathered and destroyed.

This plan may be carried out by the boys and girls on the place, or negro boys, who will find, in catching and destroying the beetles, a pleasurable pastime.

In Florida, this method should be carried out all during the month of April.

Remedies.—Spraying with a wash made of London Purple or Paris Green has been highly recommended by fruit growers, and many of those who have tried it attest to its efficacy and the beneficial results following the application.

The wash should be sprayed over the trees as soon as the blossoms have fallen.

This remedy has been strongly denounced by one of our highest authorities; but practical fruit growers highly commend it, and with reason. The beetles, whose food at this period is nearly entirely foliaceous, eat of the poisoned peach leaves and are killed before they have had time to deposit their eggs.

THE PEACH BORER. (*Sannina exitiosa*, Say.)

(A soft, cylindrical, 16-footed, yellowish white grub, with a reddish head, boring under the bark and into the crown and roots of the peach tree, causing a copious exudation of gum.)

One of the most familiar insects, destructive to peach trees in Florida, is "The Peach-tree Borer," the larva of a beautiful little moth *Sannina exitiosa*, Say, now widely distributed throughout North America.

It was formerly classed by entomologists and writers on injurious insects, in the old genus *Aegeria*, but in a recent generic revision of the family *Aegeriidæ*, by Mr. Henry Edwards, of New York City, one of our highest authorities in the Order Lepidoptera, it has been shown to belong properly to Walker's genus *Sannina*, where it is now placed.

By an inexperienced person, the male of this moth, so remarkable is the resemblance, might easily be mistaken for a wasp; and this protective mimicry, with its quick, rapid flight, undoubtedly assists it in escaping from numerous foes.

The Moth.—The moth may be found, in Florida, flying about the orchard in the day time, early in April. The female moth is much larger than the male, the wings, when expanded, measuring 1.3 of an inch; the front wings are opaque, glossy, steel-blue; the hind wings being glassy or transparent, with a blue margin. The thorax and abdomen are dark steel blue with a purplish tinge, the fourth abdominal segment having a dorsal orange colored band, while the legs are blue, banded with yellow.

The male has a wing expanse of only about an inch, and otherwise differs from the female in having all four wings transparent, bordered and veined, however, with steel blue. The color of the body is the same as the female; but, the palpi beneath, a band at base of the head, two narrow bands on its abdomen, and the fringe at its tip, are yellow.

The Egg.—The female, soon after pairing—in Florida during the month of April—deposits an egg upon the trunk of the peach tree close to the crown; it is perfectly smooth, oblong oval, of a dull yellow color, and measures about 3-100 of an inch in length.

The Larva.—From this egg, in from five to six days, hatches a tiny young borer that penetrates into the inner bark and sap-wood, as cold weather advances, gradually working its way downward into the crown and roots; and it may always be detected at work from the gummy exudations and castings issuing from its burrow.

When several of these larvæ work together, or when they have nearly reached maturity, they become exeedingly injurious, and, unless promptly removed, will almost entirely girdle the tree; if allowed, without hindrance, to complete their transformation, the final result being the tree killed outright, or its vitality so much destroyed that it will be forever fruitless.

The full grown borer measures 60-100 of an inch in length; it is of a yellowish white color, with a reddish brown head, the segment immediately following the head being paler or yellowish brown; on each of the following segments are warty-like spots from which issue short, brownish bristles. The spiracles or breathing pores along the sides are oval, and of a dull reddish color. It has sixteen legs—six true legs and ten abdominal or prolegs; the true legs are tipped with black, the prolegs, yellowish with black dots.

The Cocoon.—The larva or borer, on attaining full growth, spins a brown, oblong oval cocoon, interwoven with its castings, excrementitious particles, pieces of bark, etc., within which it transforms, almost immediately, into a pupa.

The Pupa.—The pupa, removed from the cocoon, measures 80-100 of an inch, and is of a brownish yellow color; the abdominal segments, excepting the three terminal ones which have but a single row, each have a double row of transverse spiny tubercles, and the sutures are dusky.

The moth issues from the pupa in from eighteen to twenty-four days, when the cycles in the life history of the peach borer are completed.

PREVENTIVE MEASURES AND REMEDIES.—Many remedies have been tried and recommended for this pest; but, up to the present day, none are entirely satisfactory, and at times the knife must be resorted to for its removal.

Now, however, that its life history in Florida is known, I believe that by carrying out the following simple plan, based on the habits of the insect, at a minimum cost we can render our trees almost *borer-proof:*

Poisoned Wash on the Trunk.—In the life history of this moth, as given above, it has been shown:

First. That it is single-brooded, i. e., produces but a single brood of young during the year.

Secondly. That the moth issues from the pupa during April, and,

Thirdly. That it is during this month that they pair, and deposit eggs on the trunk of the tree close to the crown from which come the borers.

What inference naturally follows?

Why, prevent the moth from laying the eggs, or destroy the young borers before they have had time to penetrate under the bark, and the evil ceases.

This is, I believe, entirely practicable, not only against the attacks of this borer, but others of a similar character, when their life histories are thoroughly understood. These are the practical and economic results that are to follow scientific investigations, and where the horticulturist and agriculturist are to be benefited from studies into the habits and development of injurious insect pests made by the trained entomologist.

It is believed the following recipe will prove an effectual preventive against the attacks of the peach borer, and is being experimented with in the Station work

Poisoned Soap Wash.—Formula No. 1.

Soap....................	1 pound.
Paris Green or London Purple...	1 ounce.
Water...................................	2 galls.

See that the soap is thoroughly dissolved in the water before adding the Paris Green or other poisonous ingredient; then mix all thoroughly together. The wash now being properly prepared, the base of the trunk, from the crown upwards for a distance of a foot, is thoroughly painted with the mixture.

It is best applied with a common whitewash brush, and when applying, the soil surrounding the crown should be temporarily removed so as to insure the wash reaching the crown, and to avoid any possibility of the moth depositing an egg on any portion of the bark between the root and the trunk not reached by the mixture.

THE PEACH ROOT KNOT. (*Anguillula ? species.*)

(A minute, thread-like worm forming gall-like knots or excrescences upon the roots of the peach and other trees and plants.)

A new disease, popularly known as the "Root Knot," has recently attracted the attention of peach growers in various sections of our State, which seriously jeopardizes the future successful cultivation of this standard and profitable fruit in Florida; and its cause, origin, and prevention are earnestly sought for by our horticulturists.

Within the past few months, the evil seems to be on the increase, and an investigation of its nature, and a solution of the many problems involved, are being attempted at our Experiment Station.

Our investigations and experiments are still in their incipiency, and the time during which they have been conducted is yet too brief to obtain definite results, and no particular value can be attached to their publication now.

Still, we have a prospect of ultimate success, and some facts discovered respecting the nature of this new trouble, its effects upon the tree, etc., justify a brief notice of it here.

Pathological Condition of a Tree Affected with Root Knot.—To a practiced eye, a peach tree badly affected with the root knot, presents a generally debilitated appearance; the usual amount of chlorophyl in the leaves is wanting, while some of them are dry, yellow, and parched; the fruiting power is greatly lessened, the majority of the fruit dropping long before the ripening process begins; some of the twigs and branches die, and there is a drooping, sickly appearance about it not perceptible in strong, healthy trees.

An examination of the roots of these sickly looking trees, reveals multitudinous tuberous swellings, knotty galls or excrescences strung out—usually a slight distance apart, but frequently contiguous and pressing upon each other—along all the fibrous and smaller rootlets, and to a much less degree on some of the larger roots.

ITS CAUSE.—On making a microscopical dissection of some of the galls, I find—in some of them—coiled up in the interior, a minute, thread-like worm, which I believe, with Prof. F. L. Scribner, of the United States Department of Agriculture, who was the first to detect these worms, to be the cause of the trouble.

This little worm belongs to the Order *Nematodes*, and is closely allied to several well known forms parasitic on man. The human round worm *Ascaris lumbricoides*, Linn, living in the intestines; the pin-worm, *Oxyuris vermicularis*, Linn, living in the rectum of children; the hair-worm *Gordius aquaticus*, Linn, living in grasshoppers, caterpillars, etc., and the hog-worm, *Trichina spiralis*, Owen, producing the well known disease, Trichinosis, in man, are good examples, although many others might be cited, whose habits and life histories are familiar to the physician and scientist.

In this country, comparatively little study has been given to the *Anguillulæ*, and almost nothing is known of our species, and whether any of them are identical with the forms found in Europe. My thanks are due to Dr. George Dimmock, of Cambridge, Mass., for kindly sending me a list of the continental works treating upon these animals; it comprises the names of some twenty-two authors who have made special studies on their structure, classification and habits, and some of these works will have to be studied and consulted before I can properly place the species depredating our peach trees.

The habits of some of the Anguillulæ are known: *Anguillula tritici*, Needham, produces a gall in the heads of wheat; the vinegar worm, *Anguillula aceti*, Ehrenberg, but two millimetres long, is a common species found in vinegar; while many other species are found in damp, moist soils, on the roots of plants, in flowers, and in various decomposing substances. Greef records *Anguillula radicicola* from the roots of *Dodarxia*, *Poa*, *Triticum*, *Sedum*, etc., and a species probably closely related, if not identical with it, is found here in Florida on the roots of grass, tomato, bean and other plants.

EXPERIMENTATION FOR REMEDIES.—The following remedies for the destruction of this pest are being tried, but no definite results can yet be given.

EXPERIMENT NO. 1.—BISULPHIDE OF CARBON.—With the aid of a pointed stick, small holes were made all around a tree, so as to reach the affected roots, and a small amount of the fluid was poured into each hole and then closed up with earth. It is believed this mixture will either kill the worms or at least act as a counteroderant and prevent their attacks.

EXPERIMENT NO. 2.—CHLORIDE OF LIME.—This preparation was applied in the same way as in Experiment No. 1, but what effect it will have on the anguillulæ is not yet known.

EXPERIMENT NO. 3.—COMMON SALT.—Salt, as is very well known, is distasteful to many worms, either killing or driving them away, and has frequently been applied for this purpose with decided success. It is being tried with the peach anguillula.

THE CORN APHIS. (*Aphis Maidis*, Fitch.)

(Green plant lice—the winged individual, with a black head and thorax, living in communities, on the leaves of sorghum and corn, and puncturing and feeding on the oozing juice.)

About the middle of May countless myriads of a small, green aphis were observed to have attacked the Sorghum, Broom and Kaffir corn, growing on the College experimental grounds. In such numbers were they, crowding and jostling each other on the leaves, particularly in the leaf axils and at the base of the seed tassels, that grave fears were entertained that the entire crop would be destroyed before a remedy could be applied. Fortunately these fears proved groundless, as several predaceous and parasitic insects had already begun preying upon them, and with their friendly services and an application of a wash, the number of the aphides soon rapidly diminished, and no serious apprehension is now felt for the crop.

This green plant louse, from which so much damage was apprehended, is the corn aphis (*Aphis maidis*), originally described by Dr. Asa Fitch, the celebrated State Entomologist of New York, in his second report, published in 1857.

It has been discovered subsequently, however, in several of the Western States on corn and sorghum. Dr. Cyrus Thomas, formerly State Entomologist of Illinois, treats of it in the Eighth Report of the Noxious and Beneficial Insects of Illinois, and his successor, the able present incumbent of that office, Prof. S. A. Forbes, has given us a much fuller history and description of this aphis and its enemies in the twelfth report.

The species on the corn has been shown to be a strictly *viviparous form*, and there exists, unquestionably, an *oviparous form*, having some other food plant, which migrates from it to the corn, as has been shown to be the case with the hop aphis (*Phorodon humuli*, Schrank). It is always important to discover this form in order to thoroughly understand the migrations and life histories of many species in the family *Aphididæ*, and a special effort will be made the present summer to discover this form, and find out from whence came the corn aphis. The field of corn affected by them is contiguous to a rich hammock, and many trees and plants growing in it were found to be affected with many species of aphides, and it is not improbable that some one of these will prove to be the migrating form of the corn aphis.

The description of this aphis is as follows:

Wingless viviparous female.—Length, eight to ten inches; long ovate, and of a pea green color. The antennæ are short, not reaching to the base of the abdomen, the basal joints pale, the terminal joints dusky, eyes brown. The beak is very short, not reaching beyond the middle coxæ, the tip swollen and dusky. All the legs dusky, excepting the bases of the femora, which are pale. Honey tubes short, slightly swollen in the middle, and black. The cauda, too, is very short and black, and there is a dusky blotch beneath it.

Winged viviparous female.—Length, eight inches; head and thorax black; collar and prosternum green. The abdomen is pale green, with each of the abdominal spiracles surrounded by a reddish brown or blackish blotch; canda and honey tubes black. The wings are hyaline, with very slender, delicate veins; stigma long, lanceolate; the stigmal vein strongly curved, otherwise similar to the apterous form.

ITS NATURAL ENEMIES.—Prof. Forbes, in his report referred to above, records among the predaceous insects destroying this aphis in Illinois, the smaller two-spotted lady bug (*Hyperaspis signata*, Oliver), the plain lady bug (*Cycloneda sanguinea*), the spotted lady bug (*Megilla maculata*, DeGeer), the nine-spotted lady bug (*Coccinella 9-notata*), the icy lady bug (*Hippodamia glacialis*), and a lace-winged fly (*Chrysopa* sp.), and one internal parasite *Aphidius* (*adialytus*) *maidaphidis*, Forbes.

All of these insects have been noticed preying on it here but the last mentioned. Besides, two species of Syrphid flies and two other internal parasites have been reared from it by me, one of which is very closely related to Forbes' *Aphidius maidaphidis.*

It is very gratifying to me to be able to still further add to our knowledge of the internal parasites of this insect, and below I submit descriptions of these two species, both of which are new to science:

Aphidius flavicoxa, n. sp., female.—Length, .07 to .09 of an inch; head and thorax shining black; abdomen flavo-testaceous, slender, pointed ovate, and longer than the head and thorax together; eyes and antennæ dark brown; antennæ thirteen jointed, reaching to the base of the abdomen, the two basal joints yellow; clypeus, mandibles, labial and maxillary palpi and legs, including all coxæ, yellow; a dusky streak along the superior edges of the femora, while the tips of posterior femora and tarsi are obfuscated; tegulæ and base of shoulders yellow; wings hyaline, pubescent; veins and stigma, brown; the radius somewhat abruptly, angularly bent near the tip. The male differs from the female in having longer fifteen-jointed antennæ, that reach to the tip, or slightly beyond the tip, of the abdomen.

The abdomen is fusiform, much more slender and darker colored than in the female, being more of a rufo-testaceous, the pedicel or first joint long, while the legs are also darker and of a decided brown color.

This species approaches nearest to *Aphidius maidaphidis*, Forbes, but in that species the hind coxæ are described as being *black*, whereas in this species *all* of the coxæ in both sexes are *yellow*.

Described from many specimens reared from parasitized aphides between May 18th and 26th.

Pachyneuron maidaphidis, n. sp., female.—Length, .06 inch;

black, with metallic brown tingings, the metathorax and abdomen more decidedly metallic. The head and thorax, under a strong lens, show a fine, scaly punctuation. Palpi dusky. Antennæ, the scape and pedicel smooth, shining black; flagellum, brownish black, and covered with a whitish pile. All coxæ and femora black; trochanters, apical tips of femora, tibiæ and tarsi, excepting the terminal joint, yellowish white; wings hyaline, pubescent; the veins dark brown, the marginal vein, the characteristic feature of the genus, being very much thickened.

This species is very closely related to *Pachyneuron aphidivora*, Ashm., described by the writer in Bulletin No. 14, U. S. Department of Agriculture, page 14, reared from *Aphis brassicæ*, Linn, but differs from it principally in the general color, and decidedly in the color of the antennæ, abdomen and legs.

Described from several specimens bred May 26th.

Remedies.—Experiment No. 1.—On May 18th the following wash was prepared and sprayed, with a very poor instrument, on several rows of sorghum affected with the aphis:

White Hellebore.................	1 pound.
Flour................................	3 pounds.
Water................................	1 barrel.

The flour was used to give body and an adhesive quality to the mixture, and all the ingredients were thoroughly stirred together and dissolved, as far as possible, before application. May 19th, twelve hours after the application, an examination revealed a very large percentage of the aphides killed and others very weak and dying, but the experiment was not entirely satisfactory, and I cannot recommend it at present. Further experiments must be made before I can definitely and finally decide as to its merits.

RED SPIDER ON CASTOR BEAN. (*Tetranychus telarius*, Linn.)

(A minute, garnet-colored mite, living on the under surface of the leaves of the castor-bean and other plants, weaving a fine web, and puncturing and feeding on the sap and epidermis.)

On May 15th a castor bean tree on the premises of Mr. Edwin P. Holmes' place, at St. Nicholas, Fla., was observed to be attacked by millions of red mites; their webs covered every leaf, and the leaves presented a glossy, dry, yellow blotched appearance, as though they had passed through a terrible scalding. Many of them, too, were sucked dry and entirely killed from the innumerable punctures of these minute depredators. The under surface of all the leaves were literally swarming with millions of these mites, in all stages of growth, giving a splendid opportunity for making a thorough biological study of the species, of which I have not failed to avail myself.

The species proved to be the *Tetranychus telarius*, Linn, an omnivorous depredator, familiar to most gardeners, on many varieties of plants, shrubs and trees, both in the hot-house and in the garden.

It belongs to the family of spinning mites, *Tetranychidæ*. and Mr. Andrew Murray, F. L. S., in speaking of the species in his classical little work, "Economic Entomology," says: "This and most, if not all, the species of the genus spins a web on the back of the leaves of the finest and most delicate texture. The threads of its web are secreted from a conical nipple, situated underneath, and very near the extremity of the abdomen. They are drawn out and guided by the motion of the insect, and by the action of the minute claws and hairs of the legs, which seem to be only used for this purpose. The threads are so slender that we fail to see them, even with the assistance of a magnifier, until after they are woven into a web or network. In the construction of this web all the feet are moved with great agility, but the movements of the mite itself are not quick, and it moves with difficulty over smooth and polished surfaces, as over glass. Upon leaves, especially on the underside of them, it finds a fitter hold, for, supported on the bristles that jut out beyond the claw, it spins its web, affixing the threads to the prominences and hairs of the leaf, and under this shelter a colony, consisting of many of both sexes in maturity, and the young, in all their ages, feed and multiply with rapidity. The plant soon shows the influence of their presence in its sickly yellow hue; the sap is sucked by myriad insect moths from the vessels of the leaf, its pores are choked by excremental fluids, and the gardener mourns the inefficacy of his remedies and the loss of his cherished flowers. The mode in which they feed is by eating their way into the leaf with their nipping mandibles, and then plunging in its barbed sucker and sucking the juice."

The various stages of the growth of this mite, as observed by me, are as follows:

The Egg.—When first laid it is of a greenish-white color; in shape spherical, and measures about 1-100 of an inch in diameter. It then becomes blood red; afterwards the coloring matter begins accumulating towards one side, the other portion becoming whitish, and an indistinctly defined mite soon becomes plainly discernible through the body wall, having six legs drawn up under the thorax.

The Young Larva.—The young mite just hatched is but 1-100 of an inch in length, of an ovoid shape, the smaller end being the tail, and of a pale, greenish white color, with sometimes a few reddish granules, visible through the skin, on the back. It has but six legs, all hairy, and there are long hairs issuing from various parts of the body. In shape and general appearance it reminds one of a *Tyloglyphus* mite; indeed, so remarkable is the resemblance, it is with difficulty distinguished from one. At the next moult, or casting off of its first larval skin, *eight legs appear*, its size is greatly increased, and it assumes the characteristic features of the mature mite, but it is still of a paler color than the mature mite, and the sexual organs are not yet fully matured. Although the color is darker than in the first larval stage, it still exhibits a broad, pale, longitudinal dorsal stripe.

The Mature Mite.—It is at the next moult that the sexes are well defined, when it has obtained its full growth. Now the female is broadly oval, sparsely hairy, and of a deep garnet red color. The head, palpi and legs, excepting the coxæ, are pale, yellowish green; the legs long, six-jointed, and sparsely covered with long, white hairs.

Au contraire, the male is obovate in shape, and is readily distinguished from the female by its smaller size, paler color, and by always having two distinct black ocelli on the cephalothorax, a character, too, sometimes distinguishable in the preceding stage. The female measures less than 3-100; the male, about 2-100 of an inch.

ITS ENEMIES.

Several predaceous insects were observed preying upon this mite, but in such few numbers as to make no appreciable diminution in the myriad ranks of the mites, although the fact is worthy of being recorded.

The insects were as follows: The plain lady bug (*Cycloneda sanguinea*, Linn); a small black beetle (*Scymnus cervicalis*); a chrysopa fly (*Hemerobius*, sp.); a thrips (*Palæothrips*, sp.), and the larva of a minute cecidomyious fly.

REMEDY.

The following wash, as formulated by the English entomologist, Miss Eleanor A. Ormerod, has been proven to be entirely efficacious in destroying these mites, and it would be well to use it for removing the orange leaf mite (*Tetranychus* sp.), so prevalent in some of the orange growing sections of our State:

FORMULA.

Sulphuret of lime	4 oz.
Soft soap	2 oz.

To each gallon of water, which is to be gradually poured on, the mixture being stirred during the time, when a uniform fluid will be obtained without sediment, which may be used when cold enough to bear the hand.

BOTANICAL SECTION.

REPORT ON "FOOT-ROT" AND "SCAB" OF CITRUS TREES, AND ON THE PREVENTION OF ORANGE "RUST."

By A. H. Curtiss, Botanist.

The following report embodies, in condensed form, a large amount of information gathered with a view to a course of experiments on those little understood diseases of the orange and lemon known in Florida as "foot-rot" and "scab," to which are added some observations on the prevention of the "rust" of oranges. As such experiments require considerable time for development of results, it is deemed best, without delay, to communicate to the public all known facts bearing on the nature of these diseases and on the means of prevention and cure. By this means orange growers will be enabled to study these diseases more intelligently, and to engage in investigations and experiments in conjunction with those which may be undertaken by the Experiment Station.

Fungoid Diseases are those caused by the parasitism on living vegetable or animal tissues of certain species of that order of cryptogamic plants called fungi. These low forms of vegetation, including the mushrooms, moulds, etc., are extremely various in form and obscure in development. None of them are green, and none have organs corresponding to leaves or flowers. Yet they have organs of reproduction, by which are developed seed-like "spores" of minute size and numerous beyond conception. These float in the air, unseen save as "motes in a sunbeam." The spores of every fungus, within its habitat, seem to be everywhere ready to germinate when they come in contact with the natural "matrix" of that species, be it a fallen branch or leaf, a decaying orange, a blade of wheat or head of rye.

The attacks of parasitic fungi are so insidious that they can be guarded against only by understanding the natural history of the species, and for this knowledge we have to rely on a few experts who make the study of this order a specialty. Having ascertained that a disease is caused by a fungus, the remedy may be excision or the application of some substance that is known to be destructive of fungii.

Such substances, called fungicides, are chemical compounds of sulphur, copper, iron, lime, soda, ammonia, etc., and they are applied either in dry or liquid form, rarely as gases. The United States Department of Agriculture recently issued a circular on fungicides, containing 23 formulas, which will be sent to any applicant. Very interesting experiments may be made by spraying or dusting with such substances any vegetation affected with mildew, smut, rust, etc.

For applying liquid fungicides (or insecticides) two nozzles are recommended in this circular, namely, the Vermorel nozzle (made by Thomas Summerville & Son, Washington, D. C.), and Nixon's Climax nozzle (for which Mr. E. Bean, of Jacksonville, is agent for Florida.) Following are the formulas of some of the liquids believed to be most effectual:

1. Sulphate of copper (blue vitriol), 1 pound dissolved in 25 gallons of water for spraying, or 5 to 8 pounds in 10 gallons for soaking seed wheat, etc., to destroy spores of smut.

2. Dissolve 16 pounds of sulphate of copper in 22 gallons of water, in another vessel slake 30 pounds of lime in 6 gallons of water. When the latter mixture has cooled, it is slowly poured into the copper solution, care being taken to mix the fluids thoroughly by constant stirring. It is well to have this compound prepared some days before it is required for use. It should be well stirred before applying.

This is known as the Bordeaux mixture, and used as a preventive of the mildew and black rot of the grape, and for blight and rot of the tomato and potato. It is recommended to modify the above formula by dissolving 4 pounds of the sulphate of copper in 16 gallons of water, and adding 4 pounds of lime after being slaked in 6 gallons of water and cooled.

3. Dissolve 1 pound of sulphate of copper in 2 gallons of hot water; when completely dissolved and the water has cooled, add 1½ pints of commercial ammonia (strength 22° Baume); when ready to use dilute to 22 gallons. The concentrated liquid should be kept in a keg or some wooden, earthen or glass vessel.

This is known as Eau Celeste, and is a favorite remedy for mildew, blight, rot, scab, and similar diseases. A modified and perhaps a superior formula is the following: Dissolve 2 pounds of sulphate of copper in 2 gallons of hot water; in another vessel dissolve 2½ pounds of carbonate of soda in a similar manner; mix the two solutions, and when all chemical reaction has ceased add 1½ pints of ammonia (22° Baume); then dilute to 22 gallons.

Latest reports from French experimenters show that the Bordeaux mixture and Eau Celeste have proven most effectual, and it will be well to give them a trial in this country wherever diseases of this character are to be met with. The grape, probably, is most damaged by diseases of this nature, but no plant is exempt from fungoid parasites. On the citrus trees of Europe 190 species of fungi have been detected. On those of Florida there are, undoubtedly, a great variety of these more or less parasitic growths, but the subject has not yet been investigated. Till very recently their injurious effects have attracted no notice; and it seems, indeed, that diseases of fungoid origin, have but lately made their appearance on the citrus trees of this State.

FOOT-ROT, SORE-SHIN OR GUM DISEASE.

(Called *Mal di Gomma* in Italy.)

ORIGIN AND DISTRIBUTION.—The disease of orange trees, commonly known as "foot-rot," seems to have made its first appearance in Florida about twelve years ago. Few persons, however, remember to have observed it earlier than the year 1880. Equally bad cases are found at points on the eastern and western coasts and in the interior, the worst being in old settlements and in certain locations, which will be described later. To specify localities in which the foot-rot is worst developed would not further the object of this paper, which is to point out means of cure, prevention and ultimate eradication of the disease. It is proper to say at the outstart that unless this disease assumes a different form, it offers no obstacle to the development of Florida's favorite industry.

The foot-rot is considered to be identical with the gum disease, or *gomma*, of Europe. Therefore, it is fair to assume that it was introduced from Europe, and that it will be affected in like manner by any methods of treatment which European orange growers may have tried. Hence, it is important to study the history of the disease in Europe for instruction and guidance in dealing with it here. A fund of information has been placed in the writer's hands by Mr. D. Houston, superintendent of the Belair grove, in the form of an elaborate treatise on the *gomma* of Italy, prepared by General H. S. Sanford, the proprietor of Belair. From this it appears that the *gomma* appeared first in the Azores in 1832, and in ten years destroyed one-quarter of the citrus trees on those islands. Then it began to decrease, and in 1873 had nearly disappeared. The disease showed itself in Portugal in 1845, and thence spread eastward, reaching Messina in 1863. Since then it has spread throughout Sicily, and has done damage estimated at $2,000,000. Having crossed the Atlantic, it is not probable that the disease will be confined to Florida alone. Fatal cases of it have occurred in green-houses at Washington, and it may already have been introduced in other orange growing States.

HOW THE DISEASE DEVELOPS.—The prominent symptoms of foot-rot are exudation of a gummy or sappy fluid from near the base of the trunk, and decay of the bark in that region and of the roots below. The flow of gum and attendant decay extend upward and in a lateral direction, until it is girdled, also penetrating successive layers of wood. In some cases gum exudes from cracks in various parts of the trunk, or even on the branches, and in others the decay progresses without emission of gum. Attendant or premonitory symptoms are excessive and rather late blooming, the flowers being small and mostly unfruitful, and arrested or unnatural development of the foliage, which becomes yellow and drops. The disease manifests itself in the top, on the same side as at the base, and makes like progress above and below.

Messrs. Gillet Brothers, of South Lake Weir, have had experience with a bad type of this disease at points in Marion county. They describe its progress as follows: "It almost invariably originates at the base of the trunk, and soon destroys the main crown or lateral roots. About the first indication of the disease is a foamy or frothy substance exuding from a crack in the bark. The sap seems to be sour, and works exactly as wine or cider will from the bung of a barrel. In cutting out this diseased part very often a small pocket of gummy substance will be found. The wood in the vicinity of the trouble looks yellow and diseased, and smells sour. If not arrested at once it soon follows the large roots back into the ground, and the tree presents a yellow, sickly appearance. Unless trees are treated promptly they will die in from one to two years. The leaves turn yellow and begin to shed, the trees put on little, if any, growth, and present a generally bad appearance. The last year they put on a tremendous amount of bloom, and, if the trees are not too far gone, they will yield as fine fruit as was ever eaten; but this is the last, and soon the trees are fit only for firewood."

The foot-rot, sometimes called "sore-shin" or "cracks," is variable in development, and is often confounded with disorders arising from freezing of the sap, severe pruning, etc. The former cause leads to a cleaving off of bark, and the sudden removal of tops for the sake of budding occasions more or less decay of roots, but in both cases there is a natural arrest of decay instead of an extension of it.

Professor Briozi describes the development of the disease in Sicily thus: "A fluid substance, dark, muddy and of bad odor, which looks like gum, but a gum *sui generis*, which appears decayed, is seen in great quantity, more or less suddenly, on the trunk of the tree or directly on the root. The bark, where attacked, splits, rises, dries or rots, and the foliage at first becomes yellow, and little by little it loses its strength and dies." In Florida the disease sometimes takes on the same malignant form as in Europe, but, as a rule, it is of milder type and less inclined to spread.

How Different Kinds of Citrus Trees are Affected.—It is agreed by all who have had experience with this disease in Florida that it is almost exclusively confined to sweet seedling trees and to budded sweet stocks, the latter being less affected than the former. There are a few reports of its appearance on the lemon and on sour orange stocks, but there is reason to doubt their correctness in most cases. In one instance the trees were sweet tops on sour stumps, and as the gum is described as appearing four or five feet from the ground it is probable that it issued from the sweet wood, and that the decay of the sour trunks and roots was caused by contact of the gum in flowing downward. It is probable that most reported cases of foot-rot in other than sweet seedling trees or stocks that did not originate in this manner are merely the effects of injuries by frost, pruning, deep planting, etc.

The resistance of all but sweet orange seedlings to the attacks of the foot-rot or *gomma*, gives further support to the idea just advanced, that the disease develops in milder form in this country than in Europe. According to General Sanford's report, in Spain and Portugal "lemon and sweet and sour orange trees were equally attacked, but the last least, and damage caused to them was slight." He states that in Sicily "the evil once commenced goes on with increaiing force from year to year, attacking in preference the lemon. The Bergamot and Mandarin and wild orange are the most free from the disease."

Apparent Causes.—European investigators have regarded the *gomma* as a diseased condition resulting from the parasitism of some microscopic fungus. Professor Eng. Giovanni Briozi claims to have discovered this fungus, and has named it *Fusiporium Limoni.* He admits, however, that it may be "a simple incident of the disease, as a superficial fungus attracted there from the state of decomposition in which the disease tissues are formed." It is difficult to determine, oftentimes, whether the presence of fungoid life should be regarded as cause or effect, since wherever decay exists one or more species of fungi are to be looked for. Decayed orange roots sometimes become enveloped with a common species of *Stereum*, yet its presence, surely, is consequent on the decay, and so it may be with the *Fusiporium* detected by Briozi.

Specimens of the diseased tissues and gum were sent by W. W. Dewhurst, Esq., of St. Augustine, to Professor F. L. Scribner, chief of the section of vegetable pathology of the Department of Agriculture at Washington, but he failed to find any such organisms as Briozi describes, and in replying to Mr. Dewhurst he expressed himself as follows: "I doubt much if it is due to either insects or fungi, but think it arises from some physiological derangement not yet clearly understood." While it is not proven that this disease has its origin in cryptogamic parasites, yet there is circumstantial evidence to support Briozi's theory, to which reference will be made in the next section.

Leaving the fungus theory out of the question, it has been observed that certain external conditions promote the development of the disease, and are to be regarded, perhaps, as among the direct causes. Foremost among these is lack of proper drainage. Trees especially subject to foot-rot are sweet seedlings with "wet feet," i. e., growing over hard-pan or in soil too retentive of moisture and not artificially drained.

Mr. S. H. Norton, of Eustis, Lake county, says he has seen trees affected with foot-rot in several localities, and in every case clay came near the surface and prevented the surface water from draining off. Consequently, after a heavy rain the trees had "wet feet."

Mr. P. W. Reasoner, of Manatee, thinks that standing water is a principal cause, and states that the greatest destruction of orange trees by foot-rot in that locality is traceable to a season of excessive rain-fall which occurred eight or nine years ago.

Mr. A. L. Duncan, of Dunedin, Hillsborough county, says the disease is not confined to low lands, though trees set low and in excessively wet seasons have been most affected.

Mr. J. B. Anderson, of San Mateo, Putnam county, states that he has seen it on all kinds of land, high and low pine, high and low hammock, but mostly on low clay hammock.

Messrs. W. W. Hawkins & Sons, of Lake George, write: "It has, we think, been most apparent in the lowest portions of groves, and with trees that have never been removed, but cut off and grafted where grown."

Deep planting and improper fertilizing are recognized as causes leading to foot-rot. Mr. P. W. Reasoner, of Manatee, writes: "Deep planting is probably one cause, but I do not think removing earth of any value, unless the tree is raised bodily (with lever, chains, etc.) I think, also, that elements of acidity in the soil, and unsuitable and fermenting manures, are among the causes." Rev. W. F. Nigels, of Dunedin, attributes the disease to cow-penning, as he observes that only cow-penned groves in his neighborhood have been thus affected.

These observations accord with the report of General Sanford, which states that in Sicily experience has demonstrated the following facts: "(1.) Irrigated trees are more disposed to this disease than those cultivated by the *dry* process, without 'pockets' (depressions scooped out around the tree for water). (2) Rich, clayey soils favor the development of the disease; land inclined and sandy, the contrary. (3) Excessive fertilizing, humidity and frequent workings aggravate it."

MEANS OF PREVENTION AND CURE.—Taking up General Sanford's report again, it will be interesting to note afterwards how well a few years experience in Florida accords with the much longer experience of the European orange growers, as to means of averting this disease. In Europe it is found advisable to bud high on resistant stocks from healthy trees; to plant groves with a southern exposure and porous subsoil; to provide surface ditches where needed; to cultivate clayey soils deeply; to be cautious in fertilizing, irrigating, cultivating and pruning; to throw powdered gypsum over the tree tops in spring (to stimulate the circulation of sap); to keep the collar of the tree clean; when gum appears, to remove with a knife all diseased bark and wood till the healthy wood is reached, extending the cut well upwards, and burn the portions cut off; then to wash with an antiseptic solution (of blue vitriol, for example) and cover with a mixture of clay and cow dung.

The above conclusions in regard to the *gomma* coincide, in the main, with those of persons who have observed the foot-rot most closely in Florida. Many have treated the disease successfully by removing the affected parts and coating the cleaned surfaces with various substances, the latter process being evidently of least importance. The following experiences are cited as examples:

Mr. Aaron Warr, of Georgetown, Putnam county, had a lemon tree, budded on a sweet orange stock, standing near his dwelling. After it had been in bearing for some years, he observed an exudation of dark brown gum from a split in the bark a few inches above the crown of the root, the diseased place being about as large as his hand. He cut away the diseased bark and wood, and made an application of hot grafting wax. The wound healed over, but presently the disease appeared in an adjacent place. This was similarly treated and healed. This experience was continued through three or four years, until the disease had passed once and a half around the tree. Meanwhile the tree grew and bore heavy crops until January, 1886, when, with other perfectly sound trees, it succumbed to the " big freeze."

Mr. P. W. Reasoner states that at Manatee, when the disease has been noticed soon enough, and every particle of diseased root, bark and wood cut away, leaving the healthy wood clean, the earth removed from around the collar of the tree and clean soil substituted, the tree has been saved.

The treatment adopted by Rev. W. F. Nigels, of Dunedin, has been to cut out the affected spot clean, and then apply sulphur and land plaster mixed with water. The large scars remaining, when cut with a knife, show sound wood and the bark is healing around them. He changes the soil around the base of the trees, and in some bad cases has banked earth around the trunks, which has caused the trees to send downward new roots from above the wound.

The method adopted by W. W. Hawkins & Sons, of Lake George, has been simply to cut away the diseased portions till perfectly healthy wood and bark is reached. This effects a cure if the disease has not progressed too far.

Maxwell, Anderson & Co., of San Mateo, Putnam county, find that the disease can be cured, if it has not extended more than one-third or one-half around the trunk of the tree, by removing the soil from around the tree, cutting away the diseased parts and coating the wounds with coal tar.

Messrs. Gilbert Brothers, of South Lake Weir, in the letter previously quoted from, say: "We have used the knife, cutting away diseased parts, and then applied a wash of copperas, lime, sulphur and carbolic acid. In this way we think we have saved two large trees, but nothing seems to permanently stop the progress of the disease. We can apparently check it, but the trees eventually die, and we are replacing with sour budded trees, which are doing finely."

As bad a case of foot-rot and as remarkable a cure as has been witnessed in Florida, occurred in the grove of Mr. C. M. Bevan, of St. Augustine. A year ago his grove seemed to be hopelessly diseased, the trunks almost girdled at the base, a fetid gum flowing from them, and almost all the lateral roots rotted and black. Having observed a like disease while traveling in Italy, and remembering a remedy that was recommended for it, he obtained a carboy of sulphurous (not sulphuric) acid, diluted it with water, and after removing the earth from the diseased roots he had them and the trunk washed repeatedly with the acid, and had flowers of sulphur sprinkled among the roots. This treatment put a stop to the disease, and the trees are now quite healthy, although many of them are nearly girdled, and are deprived, apparently, of all surface roots.

The last example would seem to indicate that this disease is attributable to some organism which is destroyed by the element most fatal to fungi. That a physiological derangement would yield to such treatment, is highly improbable. Furthermore, the disease is regarded, especially in Europe, as being contagious, which is a characteristic of fungus diseases. Assuming that it is of this character, a rational line of experimentation consists in washing the diseased parts of different trees with different fungicidal liquids, such as have previously been described, and comparing results. A prompt and thorough use of the knife should be resorted to in all cases. As a most effectual prevention of the disease the use of sour orange stocks is to be recommended, and they should be budded at least a yard from the ground.

ORANGE SCAB OR WARTY GROWTH.

This disease of citrus trees manifests itself in scabby or warty excrescences on the leaves and other tender parts, particularly of the sour orange. It is caused by the parasitic growth of a fungus thought by Professor Scribner to be a *cladosporium*. The parts it attacks become distorted and seriously disfigured, and the health of trees thus affected is materially impaired.

This disease and the fungus causing it were unknown previous to 1885. In that year it appeared in the heart of the orange belt of Florida, and within a year it became generally diffused. The spores being borne from grove to grove by the wind, the dispersion of the fungus and the disease was naturally very rapid. Although the scab seems not to have reached some of the border counties, it is pretty well dispersed through the region of profitable orange growing.

VARIETIES OF TREES AFFECTED.—The scab first appeared on the sour orange, and it has been confined mainly to that variety. In 1886 it was detected on the lemon, and it is now found on that tree in most localities where it is grown. The native Florida lemon is about as badly affected as the sour orange, and European varieties are subject to it, though not to a serious degree. It appears both on seedling and budded lemons. It is found occasionally on the lime and pomelo (grape fruit), and it may probably be found on the citron, shaddock, and in fact all species of citrus.

It has been hoped that the sweet orange would resist this new disease, and thus far it has been almost completely exempt. In a few localities, however, the scab has been detected on the sweet orange. One nurseryman in Volusia county, whose sour seedlings are badly affected, finds the disease spreading among his sweet stock, being thus far confined to the Satsuma variety. Another, in Marion county, finds that the Satsuma is affected when grown close to some trees.

Thus far the fruit of citrus trees has been but little affected by the scab, yet enough to cause alarm. In some places sour oranges and lemons have been badly disfigured, and this year it has been observed near Orlando on sweet fruit. When such instances occur it will probably be found that the sweet trees stand close to badly affected sour trees.

Sweet trees certainly are very resistant when most exposed. Mr. Alfred Baily, of San Mateo, Putnam county, in giving his experience, says: "I have two or three trees that are part sour and part sweet. On these the sour limbs and leaves are all diseased, while the sweet are not affected." Mr. C. B. Pelton, of Lake Helen, Volusia county, has observed young sweet trees interlocking their branches with those of very scabby, sour orange trees, yet not in the least affected.

CAUSE AND EFFECTS OF THE SCAB.—The direct cause of the orange scab is, as has been stated, a low species of fungus. As to its origin, it may have been introduced from some other country, or it may be a new form of some species that has long inhabited some other tree, herb or grass, and that has recently adapted itself to the citrus trees. It is known that some of the lower fungi do adapt themselves to unlike forms of vegetation, and, in so doing, assume very different forms.

If there are any external conditions more favorable than others to the growth of this fungus, they have escaped detection thus far. Some conjecture that it is induced by dry seasons, or poor soil, or that it results from insect stings, but those who make the widest observations can trace no aggravating cause.

Both old and young trees are attacked by the scab, but on the latter it is most conspicuous and most damaging—except as regards fruit. However, young sour stock is almost exclusively grown for budding, and as soon as the tops are changed the difficulty disappears. This is fortunate for the nurserymen, some of whom treat it with a degree of indifference. Still, it impairs the vigor of the young trees, attacking them, as it sometimes does, when only a span high—especially when they are not in the most thrifty condition. After the sour top has been removed and the sweet bud begins to grow, the stock regains its vigor, but there is need of working the trees earlier than would otherwise be necessary.

Means of Prevention.—As this disease is so deep seated in the tissues of the leaves and young stems, it is obvious that external applications can have but little effect on it, and that anything like cure would involve the removal of the diseased parts. Before any preventive treatment is attempted, every vestige of the disease should be removed from the trees and burned, and unless a neighborhood join in doing so, it would be of little avail, for every scab is, in effect, a seed-bed, giving forth spores which may be carried to a hundred trees.

After the disease has been eradicated, its reappearance may be prevented, undoubtedly, by the use of fungicides, such as have previously been mentioned. By keeping up this treatment, of cutting and spraying, it is probable that a grove may be protected, especially if it be remote from diseased groves. A line of investigation promising best results consists in the use of different fungicides, and in studying the fungus to ascertain when it is most active in production of spores. In this manner some preventive treatment may be discovered which orange growers can employ without too much expenditure of time and money. It is probable that the fruit of the sweet orange, should it come to be affected by the scab, can be protected from the latter and from the *rust* by the same process, as some and perhaps all fungicidal substances are likewise destructive of insect life.

As regards nursery stocks, some nurserymen contemplate the use of sweet seedlings hereafter. This may become necessary, but it should be adopted as a last resort, especially on account of the liability of sweet seedlings to foot-rot. However, the latter disease is not much to be dreaded except in groves that lack drainage. In sweet orange groves, trees of the sour orange and Florida lemon should be cut down, or their tops should be altered by budding from sweet trees. By such means communication of the disease may be guarded against to a large extent. Thus far sweet trees are practically exempt from the scab, but there is reason to fear that the disease may adapt itself to all citrus trees. Therefore, too much care cannot be exercised to guard against sources of contagion.

THE RUST OF THE ORANGE.—WHAT CAN BE AND HAS BEEN DONE FOR ITS PREVENTION.

That the rust of the orange is caused by the punctures of a mite, is a fact that does not admit of question; yet many persons still hold to the theory that the presence of the mite is consequent on the rust rather than antecedent to it. Simple observation, with a magnifying glass, of the fruit as its growth progresses, is sufficient to disprove this theory, which cannot be set aside too soon, as it stands in the way of the general adoption of the only possible means of prevention, namely, the use of insecticides.

Many who recognize the true cause of the rust, are of the opinion that it will not pay to attempt preventive treatment. As yet there is no ground for such belief, and it is wiser to adhere to the contrary opinion until the question has been decided by a thorough course of experimentation. Desultory experiments have been made with various insecticides, and although they have not been thorough enough to be conclusive, yet the results, on the whole, have been very encouraging.

Three years ago a course of treatment was advised by Mr. H. G. Hubbard, in a report to the United States Department of Agriculture. His suggestions have been put in practice, with modifications, by several persons, most thoroughly, perhaps, by Mr. Alfred Bailey, of San Mateo, Putnam county. His conclusions, based on last year's experiments, are embodied in a letter dated May 15th, 1888, which is as follows:

"As to results of last year's experience, I am well pleased. Not even 5 per cent. of my oranges were rusty, and those but slightly. But, owing to carelessness, about 5 per cent. additional were slightly spotted or burned by the solution being too strong. This was caused by not having the whale oil soap and potash in every application thoroughly dissolved before beginning to use it, and on getting near the bottom of the barrel it became thick and too strong.

"My formula last season was 5 pounds whale oil soap, ½ pound concentrated potash, 1½ pounds sulphur, to 40 gallons water. But I am satisfied that was unnecessarily strong, and I think I shall leave out the potash this season. Lime and sulphur are equally efficient in destroying the rust mite. Place 5 or 6 pounds of good stone lime and 1 pound sulphur in a barrel. Add water enough to slack. Then fill up, let settle and use.

"This is somewhat cheaper, and somewhat more difficult to handle, owing to danger of whitening trees and fruit. Early in the season it would not matter much if leaves and fruit were whitened somewhat, but later the solution would have to be used clear. As to method of application, I apply with one of the Field force pumps. It has 8 feet of delivery hose, with fine spray nozzle and 2¾ feet suction pipe, mounted on frame work on top of barrel. The solution can be applied rapidly.

"The season for active operations, if we intend to keep our oranges bright, is at hand. Already the rust mite is coming. I find on some trees the leaves are swarming with them, and they will soon reach the fruit and then the work of discoloration begins."

Mr. Bailey's faith in lime is not supported by Mr. Hubbard's experience, for, after various applications of it, dry and in solution, he reports that "not the slightest effect was obtained." Neither does he approve of ashes, lye, creosote or pyrethrum. (He recommends a wash made of carbolic or creosote soap as a remedy for die-back, foot-rot, and for destroying insect and fungus parasites in general.) A person in Putnam county claims to have freed one tree of rust, simply by throwing a little lime over it when the fruit was one-fourth grown.

Mr. Hubbard found that "emulsions containing 66 per cent. of kerosene oil, and diluted with water ten times, as in applications for scab insects, do not kill the eggs of the rust mite," and that a solution half as strong does not kill all the mites. Mr. R. H. Burr, who resides near Bartow, Polk county, having a young Majorca tree affected with rust, tried dipping branches of it in an emulsion of coal oil, there being fruit upon them the size of a walnut. At maturity the fruit on the branches so treated was all bright, while the rest of the fruit on the tree was more or less rusted. Mr. Burr intends trying the remedy again this year and will report results.

Mr. Aaron Warr, of Georgetown, Putnam county, tried Mr. Bailey's formula last year and found it very effectual. W. W. Hawkins & Son, of Lake George, tried a similar formula with great satisfaction. They report as follows: "We believe it is well settled now that sulphur, if properly applied, is a sure cure for the rust. We begin early in May, before the fruit gets much size, and thoroughly spray every tree and all fruit.

"We put in an oak oil cask of 50 gallons one peck of best stone lime and 10 pounds of sulphur; on this pour quickly 8 to 10 gallons of boiling water, to make the whole slack as quickly and with as much heat as possible. After becoming thoroughly slacked, fill up with cold water. Stir thoroughly, and while in motion dip out into buckets and spray the trees, leaves and fruit, inside and out. This can be filled up and used out of about four times, or as long as any trace of the sulphur shows on the foliage and fruit. We find it preferable to dip out into buckets, rather than draw directly from the barrel, as in the latter case much of the sediment passes through the pump at the first using.

"We think early in May none too early to make the first application, and again in June. Some who have used it say May 1st, June 1st and July 1st. We have the impression that this preparation is going to be effective for the destruction of other insect pests, such as the brown scale, white scale, mealy bug, and others."

In reply to a letter of inquiry, Mr. R. D. Fuller, of Altamonte, Orange county, writes as follows: "I will state that I have tried sulphur for rust on my oranges. I tried it first in the summer of 1885, before the winter of the freeze, when at least seven-eighths of my crop was bright. Have tried it each season since, but not as largely as that year. I am satisfied that if sulphur is carefully applied it will keep off the rust mite to a great extent, if not entirely. I apply it with a bellows. As I have this season singled out rows of trees, and am trying it on them several times through the season, I shall, after a time, be able to speak with more certainty with regard to this treatment.

Mr. I. J. Brokaw, of Anthony, states that "Bishop, Hoyt & Co., of Citra, last year used on their Orange Lake grove sulphur and lime in an emulsion to destroy the rust insect. They thought it a success. They used it early in summer with a force of men. Think they used it on nearly 100 acres of grove."

Messrs. Gillett Bros., of South Lake Weir, Marion county, state that a solution of sulphur and lime has been used there with good effect. Mr. F. N. Horton, of Braidentown, Manatee county, finds that the rust can easily be prevented by spraying with a solution, the formula of which is not given. Mr. E. Bean, of Jacksonville, is advertising the "Eureka Insecticide," which is described as "sure death to the rust mite if it touches him."

It will be seen from the foregoing that the prevention of rust has been made the subject of numerous experiments, the results of which, on the whole, have been quite satisfactory, and such as to encourage the general use of sulphur, with or without whale-oil soap and other materials. All experience seems to confirm the conclusions arrived at by Professor Hubbard, which he summarized in his report as follows:

"Flowers of sulphur must, therefore, be regarded as one of the cheapest and most effective remedies for rust-mite, and it may be used to great advantage in connection with whale-oil soap or other insecticides. It may be suspended in water, and applied in spray. With proper appliances the dry powder may be sifted or blown upon the foliage when wet with dew or rain. A little wheat flour added to the powder would increase its adhesiveness."

It is probable that the last mentioned method of applying sulphur will be found most convenient, economical and effectual. Appliances may be devised by which the powder can be dusted among the foliage from a coarse sack attached to the end of a pole, or blown from bellows with a long nozzle. The same application may serve also as a preventive of scab.

The best season for attacking the mite will be learned by experience. It must be borne in mind that the eggs are not materially affected by any substance that will not injure the leaves. They require several days for hatching, and to destroy the mites hatched from them there must be a second, and perhaps a third, application of the insecticide within a week. To avoid waste of labor it is well, before attacking the enemy, to ascertain that he is present in sufficient force to do material damage. This, again, needs experience. By examining leaves here and there in a grove, with a good hand lens, one can judge to what extent the grove is infested. The mite is a honey-yellow, four-legged creature, measuring when full grown only 1-200th inch in length. Mr. Hubbard estimated that 75,000 of the mites, besides a vast number of eggs, may be found on a single leaf. When present in large numbers they appear like golden dust on the leaves, which lose their gloss and become somewhat warped. By such signs one may learn to judge of the presence and numbers of the mites without resorting to a lens.

Considering the immense damage done by this minute insect to the fruit for which Florida is so famous, in robbing it of its golden hue, in reducing its size and depriving it of its just value in the market, it behooves the orange growers to adopt vigorous measures for abating the evil. If there is a remedy at hand, simple, practicable and sufficiently cheap, it should have a general and thorough trial. The rust-mite may run its course and be driven from the field by natural agencies, and so may the foot-rot, and possibly the scab, but such chances cannot be taken in account in conducting a great industry like orange growing. Difficulties of many kinds will arise, and it will not do to succumb to them on the ground that it is "too much trouble," and "will not pay." It would pay the orange growers well to employ skillful experimentalists, like Mr. Hubbard, to study and devise remedies for all the ills to which their groves are subject. When remedies are discovered and made free to them, they should at least be willing to give them a thorough trial.

DEPARTMENT OF CHEMISTRY.

SOIL ANALYSIS.

The examination of the soil of the experimental farm, undertaken some weeks ago, has so far advanced as to enable me to report some points of interest. The analyses, given below, are to be regarded as merely preliminary. The examination will be taken up again at an early day and completed.

SOIL NO. 1.

This sample was taken near the northern boundary of the farm, at the highest point midway between the two branches that run through the farm. The depth down to which it was taken was about five inches. The soil is pretty thoroughly exhausted, and had not been fertilized in recent years (the sample came from just outside the field as now cultivated). It would be classed a high, rolling hammock, and, judging by the huge oaks, magnolias and pines now growing on the adjoining woodland, was originally of fine productiveness. Before subjecting it to analysis the sample was allowed to lie several days in the air for the purpose of drying.

ANALYSIS OF THE AIR-DRIED SOIL.

Water	0.51	per cent
Organic and volatile matter	1.27	"
Sand	96.02	"
Clay	2.77	"
Oxides of iron and aluminum	0.33	"
Lime	0.06	"
Magnesia	0.03	"
Phosphoric acid	0.07	"
Potash and soda	0.09	"
	101.15	"

No. 2.—This is a subsoil, taken from the oldest cleared and cultivated spot on the farm, at a point about 100 yards east of the west brooklet. The plot from which it was taken had not been recently cultivated or fertilized. The soil above was removed to the depth of about six inches, and then a sample of the subsoil taken down to about fourteen inches.

ANALYSIS OF THE AIR-DRIED SAMPLE.

Water	0.28	per cent
Organic and volatile matter	0.80	"
Sand	97.31	"
Clay	2.38	"
Oxides of iron and aluminum	0.28	"
Lime	0.03	"
Magnesia	0.05	"
Phosphoric acid	0.02	"
Potash and soda	0.09	"
	101.22	"

By way of contrast, I give below some analyses of soils made at the Connecticut Experiment Station:

PRAIRIE SOIL (from Illinois).

Carbonate of lime	0.88	per cent
Sand	82.86	"
Clay	7.86	"
Humus	1.57	"
Loss at 150° C	4.42	"
	97.59	"

BRICK CLAY (from Connecticut).

Carbonate of lime	4.20	per cent
Sand	64.91	"
Clay	22.65	"
Humus	......	"
Loss on ignition	6.60	"
	98.36	"

The following is taken from the Report (1887) of the Ontario Agricultural College and Experimental Farm:

ANALYSIS OF EXPERIMENTAL PLOTS.

Mixture	2.947	per cent
Organic and volatile matter	10.494	"
Sand, silica and insoluble silica	78.590	"
Phosphoric acid	0.039	"
Sulphuric acid	0.150	"
Oxide of iron and alumina	0.297	"
Zinc	0.925	"
Magnesia	0.420	"
Potash	0.086	"
Soda	0.056	"
	100.000	"

The soil of our farm is deficient in organic matter. The per cent. of clay, as given by the analyses, though not large, is perhaps somewhat too high, owing to causes which it would be out of place to discuss here. In a future bulletin we hope to give an analysis of the "clay soils," which lie but a short distance from the College farm. Some of these clays make pretty fair brick.

A soil which contains three to four or five per cent. of lime is regarded as rich in that ingredient. The per cent. of lime in our soil is small. A short distance from the College farm is soil in which lime rock abounds. A sample of this soil should, by way of comparison with ours, be analyzed. A specimen of limestone, taken from a large deposit in Columbia county, contains 93.67 per cent. of carbonate of lime, and would doubtless burn a most excellent quality of lime.

Below are given the partial analyses of some additional soils and muck, all from our farm. No. 1 and No. 2 are the same soils, so designated above. No. 3 is a sample of low, uncleared hammock, taken about 100 yards from the border of the lake south of the farm. Depth of sample about five inches. No. 4 was taken from near the same spot as No. 3. Depth of sample about three inches. No. 4 consists of very dark earth, rich in humus, and may be regarded as the richest soil on the farm. No. 3 is not so dark in color, and differs from No. 4 in that it was sampled sufficiently deep to include a large per cent. of the underlying sand. No. 5 is a sample of cypress muck.

	No. 2.	No. 1.	No. 3.
Water	0.23	0.44	0.96
Organic and volatile matter	0.80	1.27	2.08
Sand and clay	99.77	97.46	96.96
Soluble matter	0.23	0.83	
	100.00	100.00	100.00

These soils were all exposed for several days, under similar conditions, to the free access of the air. It will be noticed that the amount of water that each soil holds on to, after this treatment, varies with the amount of organic matter in each—the greater the amount of organic matter, the greater the amount of water. The uses of humus to soil are manifold, but none of these uses are, perhaps, of greater importance than the one emphasized by the above experiment—namely, it heightens the capacity of a soil to withstand drought. It does this in two ways. First, it increases the soil's capacity to absorb moisture. Secondly, it increases its power to draw up moisture from the subsoil. This is a matter which cannot be too strongly emphasized. It will not, therefore, be out of place to give some additional facts in illustration of these two propositions. Dr. Adolf Mayer, director of the Experiment Station at Wageningen, Germany, gives the following figures, showing the relative absorptive capacity of different soils:

Clay soil	50.0	per cent of its volume
Humus "	70.0	" "
Garden earth	69.0	" "
Lime soil	54.9	" "
Sandy " (82.7 per cent. sand)	45.4	" "
" " (64 " ")	65.2	" "

These figures show that humus soil absorbs most, sandy soil least water. My own figures given above indicate that the higher the per cent. of humus in a soil the more tenaciously it resists the evaporation of its moisture into the air.

The result of experiments to ascertain the capacity of different soils to draw up moisture by capillary attraction is given by the same author. The following are the heights to which moisture was drawn in 21½ hours by various soils:

Clay soil	80.0	inches
Humus soil	70.8	"
Garden earth	64.4	"
Sandy soil	36.0	"
Chalky "	28.0	"

In this respect, also, humus soil stands very high and sandy soil very low.

Florida soils are, with few if any, exceptions, of a strongly sandy type. All the greater is the necessity of our seeing to it that our soil abounds in humus, if we would counteract the effects of drought.

J. M. Pickel,
Professor of Chemistry.

No. 3.

BULLETIN

OF THE

EXPERIMENT STATION

OF

FLORIDA,

AT THE

State Agricultural College,

LAKE CITY, FLA.

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J. KOST, M. D. LL. D., Director.

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AGRICULTURE.

EXPERIMENTS WITH FERTILIZERS.

It is well known to all well informed in matters of fertilization, that the soil maintains very diverse functions in vegetable production—the most simple being its office as the support or foot-hold for the growing plant. Then, by its capillary action, it receives and maintains the moisture necessary to plant growth. But the most important of all is the chemical action going on in the soil. It is by this that the fertilizing elements are fitted for the nourishment of the plant.

The essential elements for productiveness of the soil are *thirteen*, namely: *Carbon*, *oxygen*, *hydrogen* and *nitrogen*, serving as organizons, and which constitute 95 to 99 parts in the 100 of the produced crops of the farm. These are the portions of the plant that are dissipated by burning. The other elements, which are the non-organic, are *potassium*, *sodium*, *calcium*, *magnesium* and *iron*, that are metals; and *chlorine*, *phosphorus*, *silicon* and *sulphur*, that are denominated earths—all of which inorganic substances remain in the ash when plants are burned.

Now, a complete soil possesses all these thirteen substances; but it is not common that all are possessed by the soils of ordinary farms; and when even *all* are present, some are often in diminutive quantity, and others in an insoluble state. Hence the remedies—fertilizers—must be of kinds and qualities to suit the lack of the soils respectively.

Experimentations with varieties of soils and varieties of fertilizers are, hence, of great importance.

In our Station, experiments were conducted upon the soils of lands long subjected to cropping without any fertilizing. Below are given the results of a line of experiments upon the soil of the rear of the college campus, that had, as is stated, been subjected to cultivation for over thirty years without any fertilizing. The land was high hammock, that in native state had oaks, hickory, magnolia, dogwood, ironwood and sassafras timber; but had been so run as to be literally barren.

The table here is not intended to represent the *quantity* of production, but the relative development produced by various fertilizing materials.

Farmers, by bearing in mind the character of soil here used, may secure some important practical hints for treating the soils of their farms:

Sample. No.	Fertilizer Used.	Height of plants in feet.	Color of plants.	Development.
1	No fertilizer.........	3	yellow	Spire-tassel; no ear.
2	Lime................	5	pale green	Branched tassel; sign of ear.
3	Wood ashes.........	6	deep green	Branched tassel; silk, ear.
4	Gypsum..............	5½	green	Branched tassel; silk ear.
5	Mineral Phosphate, (simple powdered rock.)...........	7	green	Branched tassel; silk. ear 8 in.
6	Stable manure.......	10	deep green	Full tassel; two ears, 8 to 10 in.
7	Mineral acidulated phospate and sal. ammoniac.........	12	deep green	Full tassel; two ears. 8 to 10 in.
8	Rye, nearly ripe.....	6	green	Medium tassel; ear 6 in.
9	Cow peas, nearly ripe	7	green	Medium tassel; ear 7 in.
10	Cotton seed.........	7	green	Medium tassel; ear 7 in.
11	Marsh muck & lime.	7	green	Medium tassel; ear 7 in.
12	Marsh muck & wood ashes................	8	green	Full tassel; ear 8 in.
13	Buckwheat, nearly ripe................	6	green	Medium tassel; ear 6 in.

This series of experimentation must not be taken as a complete one, because the dry spell of this season was a serious detriment. The estimates were made before maturity of the corn, and in this particular, also, the experiment is imperfect. Still it proves the relative value of fertilizers and their adaptations.

In the Experiment No. 1 it is proven that the soil employed in this series of experimentation was in quite a barren state, since that the stalk of the corn produced was only 3 feet high, and had only a spike-tassel, without any sign of an ear, and the color yellow.

In No. 2 the addition of lime afforded a slight improvement, which was effected by the chemical action of the lime, on the ordinarily insoluble material of plant food which this barren soil still possessed, and by which slight fertilization was produced, as the stalk of the corn was two feet higher than that of the non-fertilized soil, and the color was improved. There was a branched tassel and the sign of an ear.

In No. 3 wood ashes, in this soil, proved of more value than lime. It produced a stalk 6 feet in height, and afforded a deep green color to the blades, with branched tassel, silk and ear. Wood ashes generally possess all the inorganic elements of plants; and often (in cases of poor combustion) some organic substances likewise. Thus it proves to have additionally to its chemical action on the soil, some active fertilizing properties. It is usually of more value in sandy soil than in clay soil.

No. 4 shows the effect of sulphate of lime in gypsum. Field plaster, as commonly used is a sulpho-carbonate of lime, and with some varieties of soil is quite useful. Particularly is this the case where the soil has been much subject to washing, as on hillsides of old fields.

In No. 5 the common rock phosphate in simply powdered state was employed. The sample was the Wakulla or Sopchoppy phosphate rock. As the phosphoric acid combined in the form of rock, or native state, is largely insoluble it does not in this state afford its power in full effect. Still it has proved superior, as a fertilizer, to any of the foregoing.

No. 6 comprised a fertilizer that contains usually all the plant food required by any soil; and if this material were sufficiently abundant everywhere farmers would have no need of any other fertilizer. It produced in this barren soil a stalk of corn 10 feet high; of deep green color of blades, and with full tassel and two ears; one 8, the other 10 inches long.

No. 7 affords the production in this barren soil of corn with stalk 12 feet in height, of deep green color, with two ears, 8 and 10 inches in length. The acidulated phosphate rock, with the addition of ammonia, affords at once the full power of the phosphoric acid, and with the nitrogen of the ammonia supplies the chief fertilizing agents required for a full crop.

In No. 8 a lot of rye had been turned under on the same soil of this series of experiments. The rye was by no means a fair crop; but was carefully turned under when the milk in the berry was hardening, and the corn was then planted in the soil thus treated. It is seen that rye proves to be a fair fertilizing material.

Cow peas, in Experiment No. 9, prove superior to rye. The entire plant of peas was put under, at the proper time, which is when the pod is fully grown, and before the seed is sufficiently ripe to grow. This plant in this stage contains a considerable nitrogen and may be considered as among the very best green-crop fertilizers that we possses.

Cotton seed, represented in Experiment No. 10, has proved the equal of the cow pea in fertilizing power.

In Experiment No. 11, in which marsh muck that had been composted with lime, has proved the equal in effect to cow peas and cotton seed. In the heating process that occurs in this composting nitrogen is absorbed and held in the compost· This is a cheap and excellent material for all sorts of crops.

Marsh muck and wood ashes composted together proves, as shown in Experiment No. 12, to be a superior home-made fertilizer.

Experiment No. 13 proves that buckwheat is the equivalent of rye as a green fertilizer; and this being of such quick growth is more desirable. Buckwheat, as tested in our station, does well in this climate.

Since writing the results of this line of experimentation in our station, the Director visited the Ohio Experiment Station, at Columbus, O.—Professor Charles E. Thorne, Director--and there found a parallel experimentation with corn, which is so nearly alike in some of the results with this of ours as to induce its insertion here.

In this Ohio Station the proceeding was more circumspect, and comprised such special methods for isolation from external soil influence as to make that experimentation of greater value than that of ours.

Director Thorne procured clean, drift sand, from a beach of Lake Erie, which he took particular pains to clean still more thoroughly, so as to render it almost absolutely pure silica. This sand he placed in a series of clean boxes set into the ground out in an open field. He took care to have the boxes sufficiently high at top above the ground surface without as to prevent overflow into the boxes. The depth of the sand in the boxes was such as to afford moisture about equal to that of the surrounding soil in the field, and every other precaution was taken to make the series of experimentation as complete as possible. Below is given in tabular form the results of Director Thorne's work, and which he has kindly allowed to be used as here appended—he, himself, having copied his entries, as given in this table:

FERTILIZERS EMPLOYED. SEED PLANTED, CORN.

No. Box		Height in Inches.	Color of Plants.	Development.
1	No fertilizer used.....	31	very pale.	Tassel, no sign of ears.
2	Dissolved Bone-black	48	"	" " " "
3	Muriate of Potash.	32	"	" " " "
4	Nitrate of Soda	50	dark green	" no silk.
5	Diss. Bone-black and Muriate of Potash...	58	very pale	" no ears.
6	Dissolved Bone-black and Nit. of Soda....	77	dark dreen	" small ears.
7	Muriate of Potash and Nitrate of Soda.....	39	"	" and silk.
8	Dis. Bone-black, Mur. Potash and Nit. Soda	87	"	" silk and ears.
9	Barn-yard Manure....	57	medium	" and silk.
10	Linseed Oil Cake Meal	42	"	" " "

In the next table below there is a repetition of the test, but old field soil used instead of clean sand:

Box		Inches.	Color.	
1	No fertilizer used.	84	pale.	Stalk and tassel, ears 3 to 4 inches long.
2	Dissolved Bone-black..	102	very pale.	Do do ears 2 to 3 " "
3	Muriate of Potash.....	102	" "	Do do ears 2 to 3 " "
4	Nitrate of Soda........	95	very dark.	Do do ears 4 to 6 "
5	Diss. Bone-black and Muriate of Potash.	92	very pale.	Do do ears 2 to 3 " "
6	Diss. Bone-black and Nitrate of Soda...	102	very dark.	Do do ears 4 to 6 " "
7	Muriate of Potash and Nitrate of Soda...	96	very dark.	Do do ears 4 to 6 " "
8	Diss Bone-black, Muriate of Potash and Nitrate of Soda........	90	vary dark.	Do do ears 4 to 6 " "
	Barn-yard Manure.....	98	medium.	Do do ears 4 to 6 " "
9	Linseed Oil Cake.	96	medium.	Do do ears 4 to 6 " "

Accompanying these tables Prof. Thorne gives the following very interesting remarks: "In both series of boxes the presence of nitrogen in the fertilizer is most strikingly shown by the dark green color of the stalk and foliage, the color, where no nitrogen has been added, being in every case pale and sickly. In the case of the lake sand there is a striking difference in the altitude and general development of the plants, showing complete development of all parts, where a complete fertilizer was used, containing nitrogen, phosphoric acid, and potash. The plants which received phosphoric acid only [contained in the bone-black] or phosphoric acid and potash came most in development, while those receiving only potash show no superiority to those receiving no fertilizer whatever. Yet the necessity for potash is shown in the superior development of the plants in box 8 over those in box 6. [In first table.]

"In the case of the series in which the soil of the Experiment Farm was used there is less difference in the development of the plants, but there is the same difference in color of foliage shown in the first series. The box receiving the complete mineral fertilizer contains the shortest plants in the entire series, with the exception of that receiving no fertilizer; but the development of grain is better in this box than in any other of the series. It is intended at the close of the season to determine the weight of all parts of each plant in this experiment."

It is seen, by noting the results of the experimentations with fertilizers in our station, and that of the Ohio station, that nitrogen, as contained in the soil is exceedingly important. Every example proves this. Next to nitrogen is phosphoric acid. Carbon, although constituting the great body of plants, is not so important as a component of the soil. Carbon is almost entirely taken from the air by the foliage of the growing plant.

One important matter is determined by these series of experimentation, and which doubtless has been often noted by persons of experience in farming, it is that the indiscriminate use of fertilizers is a poor practice. Soils differ greatly in their requirements. Thus the practice of using lime, gypsum or carbon composts indiscriminately is not a good one. On the other hand, however, one cannot go far wrong in the indiscriminate use of materials rich in nitrogen, phosphoric acid or potash, unless, indeed the soil is already a very rich one.

GRASSES.

Former Bulletins afforded accounts of experiments with Northern meadow grasses, as timothy, redtop, bluegrass, &c., and the progress of their growth had been noted as measurably satisfactory. In this number, since those grasses, as also several kinds of clovers have matured, more can be stated.

It had been stated that the dry spell of weather that had occurred interfered with our experimentation. But still there has been sufficient test of the practicability of culture of those meadow grasses in Florida to warrant the conclusion that, with proper care as to cultivation, and kinds of soil selected, those grasses can be made at least moderately successful as pasture grasses, and for hay as well.

The timothy headed out and matured seed. The heads, it is true, were not so large as they commonly grow in the North, but yet they matured evenly in season. The stalks and blades of the grass were respectably well developed, and the stand was good and the plants are well rooted. Nearly as much may be said of the redtop and bluegrass.

Both red and white clover headed out moderately well, and matured seed. The stand with these is not really good, but as the season was unfavorable some allowance must be made.

The crimson clover that had been reported as eminently well developed in growth, has matured seed abundantly. It proves here to be an annual plant, since that after the seed had matured the roots died, as did the stalks. Hence this clover must be sown annually.

BERMUDA GRASS.

This grass has now established its reliability, not only as a pasture and lawn grass, but one that will yield hay of good quality. Our College campus grounds are now well covered with it, and by use of the lawn-mower has afforded a beautiful lawn amidst the shade trees.

TEXAS BLUEGRASS.

This was reported on in Bulletin No. 2 as a good success in Florida. We can still so report.

ORCHARD GRASS.

Our plat of this grass is not well set, the dry weather arrested its growth when young, while the roots had not yet penetrated sufficiently deep to withstand the drouth. Still a portion of the plat that was shaded a part of the day has a moderately good stand.

CORN.

Report of yield, to the acre, of varieties of Corn, under the same treatment and on same soil.

Old oak and hickory land (high hammock.) The soil had been exposed to commons for some years, after severe culture and no fertilizing. The corn was all planted on March 10th, after due preparation of soil, and fertilized with the Armour Blood and Bone Fertilizer, three hundred pounds to the acre. Rows 4 feet apart, one stalk to the hill, 3 feet interval.

GOLDEN BEAUTY.

Seed from the Department at Washington. Yield 43¾ bushels to the acre. Weight of shelled corn 60 pounds to the bushel. Weight of corn and cob, 73 pounds to the bushel.

CHESTER COUNTY MAMMOTH.

Seed from the Department at Washington. Yield 31¼ bushels to the acre. Weight of shelled corn to the bushel, 58¼ pounds. Corn with cob, 75 pounds.

SOUTHERN WHITE.

Seed from the Department at Washington. Yield 37½ bushels to the acre. Weight 64 pounds to the bushel of shelled corn, and with cob, 75 pounds.

COLUMBIA COUNTY CORN.

Seed selected. Yield 31¼ bushels to the acre. Weight 64 pounds to the bushel, shelled; and with cob, 75 pounds.

KAFFIR CORN.

For fodder, when cut four times in the season, the growth had been each time to three feet height, and stood full and stong. It was fed to stock and not estimated. Of seed, two rows 370 feet long, close set, yielded one bushel and sixteen quarts of seed. Weight of seed, 80 pounds per bushel.

BROOM CORN.

Five rows, moderately close set, 4 feet apart, and 440 feet long, yielded gross weight 240 pounds. Seed thereof, 7½ bushels, and weight of cleaned brush, 150 pounds.

Note.—All the weighing in the above estimates was done when the corn was not *fully* dried, and the weight part of the experimentation was therefore not complete, except as relating to the object of the experiment, namely, proportionate yield.

In this year's treatment of corn it was found that in rich soil the stand of two stalks to the hill did about equally well to one in the development and thus produced greatly more corn to the acre. The Florida practice of one stalk to the hill is not most advantageous when the soil is rich, or when well fertilized. Three stalks to the hill, however, did not increase the aggregate yield over the two stalks in sufficient amount to pay for the extra handling. All over three stalks proved detrimental proportionately as the increase was made. This, however, relates to the grain only, since that the fodder portion was increased, and improved in quality.

BULLETIN No. 4

AND

ANNUAL REPORT

OF THE

EXPERIMENT STATION

OF FLORIDA

AT THE

STATE AGRICULTURAL COLLEGE,

LAKE CITY, FLA.

JANUARY, 1889.

REV. JAS. P. DEPASS, DIRECTOR.

TIMES-UNION PUBLISHING HOUSE,
JACKSONVILLE, FLA.

INTRODUCTION.

On coming into office as Director of the Experiment Station, which was January 22d of this year, I received no notes of unreported experiments from my predecessor, and hence had no material for Bulletin 4, due January 1st. Having had many calls for this Bulletin, and a great many applications for literature on peach growing, after mature deliberation, I thought I could not better serve the public, supply the missing link between Bulletins 3 and 5, and meet the requirements of the law, than by giving my experience of over twenty years in cultivating the peach. While this Bulletin does not pretend to be an exhaustive treatise of the subject, it is written in the hope of being of some service to those who are engaged, or may wish to engage, in the business of growing this fruit, either for profit or home consumption. I have now growing on the Station a number of varieties, said to do well in Florida, and shall this fall collect others from this and other States, and, if possible, from those foreign countries whose climate and soil induce the hope that their best varieties may prove valuable acquisitions. In future Bulletins, as facts develop, I shall report them, both as regards the good and the bad, and if I introduce fruit worthy of distribution among our people, I shall take special care in doing so. I shall be greatly obliged to any person originating a new peach to send me samples, for which I am willing to pay, and will purchase buds or trees of any promising variety for trial. I shall be obliged also to have my attention called to any new insect or disease that may affect the peach or any deciduous fruit in the State.

PEACH GROWING IN FLORIDA.

Before the war the people raised peaches in abundance for home use, planting in favored spots, such as their gardens, horse and cow lots, and they rarely missed a crop. After the war an effort was made to introduce the early and choice summer varieties of other States, but failure and loss was the result. There are few, if any, of the most popular varieties of other States that will succeed in Florida. In consequence of this failure, the opinion very generally obtained that peaches would not grow here, nor was it until the introduction of the Peen-to, or Peen Tau,* in 1874 or 1875, that public attention began to be directed to this fruit, and public interest revived in favor of its cultivation.

THE SOIL ADAPTED TO ITS GROWTH.

Perhaps there is no fruit we have more generally adapted to our soil than the peach; still it is a known fact that there are exceptional places where it does not thrive. While no one can determine these localities without a trial, still it is well to note that land which is too thirsty, as well as too wet, is not suited to the peach, unless water can be supplied in the one instance, and drainage in the other. The mere fact of land having a clay sub-soil, or clay in the soil, or an absence of clay near the surface is no criterion to judge of its adaptability to this fruit, or any of the deciduous fruits that grow in our climate. I have fully demonstrated this in my own experience, and have seen the tree thrive and fruit in all classes of soil common to our State. It is a fact, beyond question, that trees in the same orchard, of the same kind, and, as far as the eye can judge, the soil in all essentials similar, receiving the same treatment, vary both as to growth and fruiting. While this is rare, still the fact exists, and there is no accounting for it, so far as I know. But, generally, throughout our entire State, where proper attention is paid the peach, the grower will be rewarded for his labor and outlay, if he will abandon the idea that it does not require either no attention or too much care, or is overfed or not fed at all.

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*Peen-to is the name among the common classes of China, but the Mandarin dictionaries use the words Pien Tau, which means flat peach.

FRESH GROUND.

Whether the land be high or low, hammock or pine, fresh land is the best, and always the best. Fresh hammock land is not only costly, but difficult to prepare for an orchard. It is also hard to work. Pine land can more easily and cheaply be put in order, and is easier cultivated. It is better to cut the timber down and dig the stumps, but it is not necessary. The peach grows among the deadened timber, and does not sustain as much injury from falling limbs and trees as they decay, or when the storms come and go, as one might expect. The Providence that paints the lily and the violet, and watches over the life of a sparrow, seems to care for the poor man's orchard, in which lies, in part at least, his resources of daily life. An orchard looks better clear of timber and stumps, but these can be removed gradually, as time and opportunity admit. The hammock is richer, as a rule, in plant food, but the difference in the cost of clearing and cultivating is largely in favor of pine land, even though more fertilizing is necessary every year; but hammock land needs fertilizing also, and it is only a question of a few years when the expense in this line will be equal. While fresh land is always best, still it is not a necessity. Old land, already devoid of trees and stumps, with much less trouble and expense, can be prepared for an orchard. In preparing an old field, first break up thoroughly, then check off the distance you wish the trees to stand; dig the holes two feet deep by three feet square, and prepare as stated under the head of *fertilizing*, and you can plant in the hope of good fruit. Another good plan in preparing old land is to place in the holes hammock mold, muck, or soil from the depressions in pine land several weeks before planting, to which may be added a pound or two of any complete fertilizer, or five or ten pounds of compost as per formula under head of *fertilizing*.

TIME TO PLANT.

The very best time is from the middle of December to the middle of January. It is much better to plant before than after this time. In December the tree is dormant or inactive, and the early varieties, such as the Peen-to type, awake about the first of January, are in full bloom by the middle of the month, and begin to put out leaves a week or so later. When the tree is in bloom, or in half leaf, to transplant it is to endanger its life or health. When a tree is set back by reason of too late planting, or becomes sickly through neglect, it is cheaper and better to dig it up and replace it with another. This year on the Station, although the season was favorable, in consequence of late planting, which was done in February, I lost a large number of thrifty trees, and those which lived, although well cultivated and fertilized, did not do so well as they would had they been planted earlier. I feel it a duty to say, that while there is one chance for deciduous fruits doing well planted after January, there are at least five against them. The first effort a peach tree makes in growing, after being dormant, is sending out delicate white, silk-like roots, which, if exposed to air, wither directly. A tree planted in December has in a month many of these little feeders, from one to five inches long, on all its large roots. These rootlets play an important part in its nourishment, and hence, if dug up when in bloom or in leaf (for when a tree begins to leaf its roots cease to grow, nor do they begin to grow again until it is in full leaf) suffers the loss of these roots, and if a short dry spell follows, their loss is easily seen in the want of vigor, and often death.

THE DEPTH TO PLANT.

In dry and sandy soils, trees should be placed deeper than in wet or stiff land. The roots should be carefully trained in their natural directions, and the dirt packed around them. When the hole is filled, if the season is dry, water should be freely applied. If planted when irrigation is used, or the land is naturally wet, they ought not to be placed deeper than they grew in nursery. This is determined by the earth marks above the roots, and then allowance of an inch or two should be made for the soil to settle.

PRUNING.

Universal experience has demonstrated the absolute necessity of pruning early and often. In California, where the peach is developed as near perfection as anywhere on this continent, some of the most successful growers begin to prune when the tree is very small. Their plan is to plant the dormant bud, and when it is two feet high to pinch off the top and cause it to branch. They then rub off the sprouts, saving five or six wood buds within six inches of the top, and train these to produce a low head and short body. The object of pruning is to keep the tree healthy and vigorous. If left alone it runs to wood, bears only at the ends, and is of little value. Headed back every year, and limbs which grow too fast pinched off and made to branch, the peach lives to an old age, and bears much fruit. The Monthly Monitor, printed at Bronson, Levy county, Fla., says, in its September issue: "There are numbers of 'native' trees in this county from fifteen to thirty-five years old that bear heavy crops of the most delicious peaches every year." Another tree is reported, thirty-seven years old, bearing fifteen bushels. Cutting back forces the lateral limbs to grow, and as the wood made one year is that which brings the fruit the next, the cutting back must be done. Limbs which grow down, or too straight, should be cut off; nor should the branches be allowed to crowd each other. The most desirable form of tree is either bowl or wine-glass shape. Old trees that have been neglected should be cut back and made to put out new wood. This sometimes kills the tree, but it is better to kill and replace with another, than to let it live and profit no one. As a rule, bearing trees should be pruned in early spring, taking off about one-third of the growth of the previous year. The judgment of intelligent growers, however, should govern them in this direction, for sometimes more should be taken off. Summer bearers, if not pruned in spring, will not fully mature fruit buds for another season.

The fall growth should all be cut off. This is mainly the cause of winter blooming. This growth, the next year, matures its buds in early fall; sheds its leaves, and bursts into bloom after the first cold spell. This growth is produced after the fruit drops in summer, and has not time to mature fully before winter.

FERTILIZING.

This should be regulated by the character of the soil. Peaches do not require the richest land, nor will they do well on poor land unless regularly and properly fed. But even the richest land will soon be exhausted by this greedy feeder, unless its strength is sustained by prudent fertilizing.

The great difficulty in the way of growing this fruit in Florida lies, first, in fertilizing, and, second, in the supply of water in the dry seasons. Water and fertilizing very greatly advances the maturity of fruit, and for early varieties this is exceedingly desirable. In seasons when we have a fine supply of water the early fruit ripens from two to four weeks sooner than when the spring is dry. The same is true of late fruit when the summer is wet. But whether dry or wet, the tree must be fertilized. If neglected it will take a year, or longer, after bearing a good crop to recuperate, or to send out its roots in fresh soil in search of food. Any fertilizer that possesses the three great elements of plant food, potash, phosphoric acid and nitrogen, will serve the purpose. But the question which will interest the inexperienced grower most is the cost of fertilizing. Commercial fertilizers are costly, and are not in the reach of every grower. I have found a compost of the following proportions to be cheap, and beneficial to third-class pine land, and prepared in the following way: I build a pen, and commence the compost by placing in the bottom of it 2,000 pounds of stable or cow manure, (muck may be used, but it is not as good as either of the other two), 333 pounds each of kainit, cotton seed meal, or crushed cotton seed, or cotton seed whole, and acid phosphate. Then begin again with stable manure, and so on. When I complete a layer I wet it thoroughly, and so on to the top of the pen. Then I cover the whole with dry dirt, and the pen with a shed. In a month's time I remove the dirt, break the pen and mix, and then shovel back and wet again, covering with dirt. In another month the fertilizer is ready for the orchard, and when removed must be well mixed again. The stable manure and cotton seed or meal will be completely decomposed. Five or ten pounds of this compost, well mixed in the hole several weeks before, either on old or new ground, in which a tree is to be planted, will give it a healthy start and a vigorous growth through the year. On a one-year-old tree ten pounds may be used, and on three or five-year-olds double the amount. This compost has been found excellent for all kinds of field and garden crops. It takes time and trouble to make it, but it saves money, and gives good results. Every farmer and fruit grower should have a compost pen with a cover to it, which should receive the refuse of the house and kitchen, especially of the stove and fireplace, the chicken coop, the stable and the cow lot. One who is dependent upon his own efforts for success and neglects this, may expect to live poor and die poor, and experience the mortification of seeing others prosper who follow what he neglects.

Lime and copperas may be used with profit around peach trees. I have tried both, and think that good has resulted from their use. From one to three pounds of copperas (sulphate of iron), according to the age of the tree. The lime may be used in larger quantities. On dry lands the mulching of trees with pine straw, wire grass, or green moss helps to retain moisture, and, to some extent, serves as a feeder. The drawback to mulching is, that it becomes the harbor of such insects as the gray and black cricket, grasshoppers, beetles and pumpkin bugs, which feed on the tender shoots and buds. It is not safe to use fertilizer of any kind when setting a tree. It should be put in the hole, and well mixed, several weeks before, and if used at all at planting it ought to be put on top of the ground.

WORK IS NECESSARY IN AN ORCHARD.

Weeds and grass must not be allowed to grow. They choke young trees directly, and are a serious injury to old ones. The plow and hoe must come into early use. A good cultivator, after breaking with the plow in early spring, is the best tool to use. Care should be taken not to break, or jar, or mutilate the roots of young trees in working, nor should the dirt be banked on them.

CUTTING BACK.

It is the almost universal experience of growers that in preparing trees for planting they should be freely cut back. Some contend they ought to be cut back to four feet, and others to two. I incline to the latter opinion. I am certain that every inch over four feet left on is a loss. Be careful to cut away every branch, and leave no fork. It is here that the borer does much harm. The tree should be trained to five or six buds within six inches of the top, and all other sprouts kept pinched off.

Many planters prefer large, well branched trees, but this is a mistake. A tree dug with the greatest care will have its roots more or less broken. It is not reasonable, therefore, that with broken and mutilated roots it can be sustained as before. Moreover, it is very susceptible to drought, and with a heavy top in a dry spring will more readily wilt and die than if cut back freely when planted. To purchasers, I suggest that they request nurserymen, who know what is best, from long experience, to prepare their trees as they should be for planting. This will protect them from loss, expense in freight and packing, and they will have better and healthier trees.

THE BEST STOCK ON WHICH TO BUD AND GRAFT.

In Europe the plum is used largely as stock to bud and graft upon. The object is to get a small tree. In France and England the peach is not cultivated in open ground to any extent. They are forced to plant by the side of walls, and to secure small stock the Myrobolan plum is used. This plum has been introduced in Florida for the object of avoiding the ravages of the borer and rootknot worm, but it is not a protection against either. The claims of various plum stocks have been advocated as better for the peach than its own roots, but thus far none of them have proven sufficiently successful as to warrant unqualified recommendation. At present great hopes are entertained by a few that the Marianna plum will serve as a protection against the borer and rootknot. This is yet to be demonstrated, and my experience does not permit me to say more than it is worthy of further trial. The peach is a coarse feeder and a rapid grower, and as yet no plum has been found to keep pace with it. The peach, when budded or grafted on plum stock, generally outgrows the plum, and the wood does not heal or adhere as readily as when on its own stock.

A question has been sprung in the Nurserymen's Association whether it is best to grow stock from the seed of native seedlings or from imported seed, and the advice has uniformly been to use native seed. The only reason I can see for this is, that the diseases of more northerly climates may thus be avoided. The yellows as yet has not made its appearance in our State, so far as I am informed, and such writers as Downing strongly urge against the planting the seed from stock in regions where this fatal disease prevails.

Candor compels me to say, that seed from a healthy region are as good as from Florida, and both philosophy and fact sustain the opinion. But very great care should be observed, first, that the seed are from healthy, thrifty trees, and, secondly, that they have matured well. In importing trees from other States the risk is very great, and the stock budded may have in it the germs of a fatal disease; and the buyer is not only a loser, but he imperils an interest which promises to become one of Florida's foremost industries. The judgment of some of the best and most prudent growers is against buying stock for budding purposes in States north and west of Florida. They contend that the stock is not so vigorous or healthy as that grown from seed of our own native varieties. The trouble lies, doubtless, in the fact that trees taken from nurseries whose soil is richer and heavier than ours suffer from the change. If stock has been forced by heavy fertilizing, and transplanted into thin, light soil, even though it be fertilized, it will feel the change very quickly. The same is true of hammock land. Trees taken from hammock are not likely to be vigorous on pine land, and the transplanting them into hammock is only a happy transition to richer food. The preference of growers for large stock compels the producer to meet the demand by forcing his stock by high fertilization. The large and thrifty-looking tree, grown in rich land, may, for a while, show better, but good, healthy, medium-sized stock, under the same attention, will do better in the end.

GENERAL REMARKS.

Suckers should not be allowed to grow, but should be taken off with a sharp knife close to the root.

Dead limbs and all sickly-looking branches should be cut off.

Winter blooming is the result of not cutting away the fall growth in the spring, of careless work, neglect of fertilizing, and want of water. The want of water can be supplied, to some extent, by pruning, work and fertilizing.

Fertilizing can be done any season of the year, but the best results are obtained by attending to it in January and June.

The distance given to trees in orchard is from twelve to twenty feet.

When irrigation, with sub-drainage, becomes general, and its advantages demonstrated, deciduous, as well as citrus, fruits will, doubtless, attain a perfection that will be surprising.

The enemies which trouble us, in my opinion, are very greatly overestimated as to the injury done by them.

The borer, common to every portion of the State, scarcely ever injures a tree after it has passed its fourth year. A keen-bladed knife is the surest, cheapest and quickest way of getting rid of it. The Entomologist suggests other remedies, to which I refer the reader.

The curculio is more to be feared, because it does greater injury than all the others; but it may be gotten rid of, to a very great extent if the directions given by the Entomologist are carried out with care. It does not infest East and South Florida, except generally where there are old-field plum orchards.

The curled leaf, or, as some term it, "Frenching," does not harm us, and is very little noticed.

The scale is also very rare. For remedy see article by Entomologist.

Rootknot produced by a diminutive worm, has occasioned widespread alarm among growers of late years. I have noticed its effects in the knots produced on the roots for years, but gave it but little attention, as I did not observe any evil results from it, except in planting young trees.

I have planted thousands of trees affected with it in thin land, but planted them deep, from eight to ten inches, and they have lived and thrived as well as others not affected. This leads me to suppose that possibly this is the best remedy for and against this enemy. Trees perfectly free from these pests have been planted in soil where they were, and in a short while they were full of them. I would not advise the purchase of trees thus affected, but I suggest, lest they are in the soil, that trees be planted deep in high and dry soils. Of course, on wet lands, unless drained, this would not do. Some have thought that the use of muck in the holes was a protection. My opinion is, that the preparation of the soil enabled the trees to resist the injury from the worm by putting on new and vigorous roots. The rootknot worm *Anguillula* is found more largely in old land, still new land is sometimes infested with it. In addition to the remedies suggested by the Entomologist, I advise those whose trees are suffering to dig holes by the side of them, fertilize them, and, after several weeks, transplant in these holes, cutting them back freely. If any one should follow this suggestion, or any remedy recommended by the Entomologist, I would be pleased to have their experience reported to me.

VARIETIES.

I am indebted to the nurserymen of Florida for the names, in part, of the following list of varieties of the peach.

These will all be planted on the Experiment Farm, and, after careful testing as to flowering and fruiting, a revised list will be made showing results, most likely reducing the list now presented to fewer varieties, with synonyms:

PEEN-TO AND SEEDLINGS OF THE PEEN-TO.—Shape flat or globular, mostly semi-cling; ripen from May 1st to June 10th.

SEMI-CLING.—Peen-to, Florida's Own, LaBelle, Southern Queen, Alpha, Barrs' Daisy, Bidwell's No. 7, Yum Yum, Lottie, Orlando, Maggie, Seminole, June Beauty, Beta, Bidwell's Late, Bettie, Wonder, King; July 1st to 15th.

FREESTONES.—Waldo Prolific, Angel, Pearson, Kerr's Free.

HONEY AND ITS SEEDLINGS.—Shape oblong, curved; freestones; ripen from May 15th to July 1st. Ellenora, Early China, Climax, Pallas, Kite, Early Cream, Horne's Favorite, Julia.

HONEY-PEEN-TO CROSSES.—Archer, Alachua, Florida.

CHINESE CLING SEEDLINGS.—Albert Sydney, Countess, Thurber, Elberta.

BLOOD PEACHES.—Red Ceylon, Indian, Cabler.

PERSIAN TYPE.—Amelia.

Amelia and Honey Cross.—Jacienne.

Native Clings.—Ripen during June and July. Dowling's Red, Big Red, Golden Press, Silver Press, LaReine, Elma, Edith, Sunset, La Magnifique.

Native Freestones.—Golden Clear, Silver Clear, Perfection, Florida Crawford, Paragon, Mammoth, Colossal, Chessers, Victoria, August Early, August Late, Watson's August, Augustus, Powers' September, Jackson's Prolific, Gibbon's October, My Favorite Yellow, My Favorite White, Thomas' Late. These freestones ripen from July 1st to October 15th, in about the order named.

ENTOMOLOGIST'S REPORT.

INSECT ENEMIES.

The insects that attack the peach in Florida are not very numerous, but with the increase in orchards these pests will most likely become a source of expense and annoyance.

The larvæ of the *Sannina exitiosa*, usually known as the borer," is by far the worst enemy of the young tree. Its habits have been discussed in a former Bulletin by Professor Ashmead, and I shall give but briefly his conclusion:

There is but one brood within the year.

The moth, or perfect form, issues from the cocoon in April, when it mates, and during that month lays the eggs, near the ground, upon the trunk of the tree; the eggs hatch, penetrate the bark, and begin burrowing in the inner bark.

To prevent the deposit of the eggs then would be a reasonable and practical inference. Various methods have been proposed, hilling up the tree one or two feet in March, wrapping the trunk with tar paper, and coating the trunk with poisoned whitewash, soap or clayey paints. I prefer this formula:

Formula 1. Take one pound of common glue, soak over night in cold water, then dissolve it in a half gallon of hot water, add one ounce of London purple; stir until the color is uniform, add hot water until the mixture measures two gallons.

During March remove the soil from the stem and crown roots, cut out all borers found, and apply the warm glue freely over the trunk for the lower two feet, at least.

Hill up the tree until the earth is above any cut surface of the trunk, and in most cases trees nearly girdled will soon repair the damage done by the borer.

Small fires at sunset in the orchard during April will destroy many moths, and this practice is recommended.

The curculio, *Conotrachelus nenuphar*, threatens to be the worst foe to the peach and plum family.

There is some controversy as to its food where fruits are absent, with the preponderance of opinion that it subsists upon the foliage of the plum or peach. My judgment is, that the latter theory is correct, from experiments made by myself and others with arsenical poisons.

After hybernation, during the short winter in Florida, the beetles take wing early in January, and as soon as the peach blooms fall, the females begin to pierce the fruit, laying eggs, one in each incision, usually three or four a day, until the stock of about 100 eggs is exhausted, when she dies.

The eggs hatch into soft, yellowish, footless worms that gradually reduce the juicy fruit to a mass of filth and rottenness, causing it soon to fall to the earth, where the worms enter and transform, emerging in May or June as perfect beetles. Then they attack the ripening fruit, tearing open the tender skin, feeding on the sweet pulp, to be followed by swarms of bees, ants, wasps and weevils, and soon by fungoid spores that destroy the fruit.

These pests feign death if disturbed, and drop to the ground, and this habit can be put to use over small areas, or with choice trees, by violently shaking or jarring the trees, preferably in the early morning. The beetles can be gathered, or a flock of chickens will render good service, and soon learn to haunt the trees during the morning round of visits.

This method is impracticable with large orchards, and spraying the trees with an arsenical mixture just as the fruit "sets" has been found very efficacious.

Formula 2. Stir slowly eight quarts of sifted flour into eight quarts of cold water, set it on the fire and stir until it boils and is thick paste; to this add four ounces of London purple, mix thoroughly, dilute with water until fifty gallons are prepared.

Formula 3. Yellow soap, four pounds, dissolve in a gallon of hot water, add four ounces of London purple, mix, dilute to fifty gallons with warm water.

Formula 4. I. Three pounds of sal soda, one pint of hot water, heat; add slowly four pounds of rosin, and gradually two pints of hot water. When dissolved add hot water to make five gallons.

II. Sal soda, one pound; arsenic, four ounces; water, half a gallon; heat. When dissolved add I to II, and dilute with water to fifty gallons.

Apply these solutions to the tree in a fine spray once, at the time of the setting of the fruit. I prefer solution 2 for the curculio alone, but No. 3 for plant lice, and No. 4 for scale and curculio.

The London purple is cheap, efficacious, distinctive in color, and very diffusible. More than one pound to 200 gallons of water burns the foliage, the heavy dews and frequent rains giving it greater continuous action than stronger solutions in other climates.

It is hardly necessary to remark that these are powerful poisons, and stock should be kept out of orchards after their use; though applied once to the fruit, at setting, there will not be a trace of it at maturity, while the beetles eating the poisoned foliage will be destroyed before they deposit eggs within the fruit.

The peach louse, *Thyzus persicae*, is occasionally found beneath the leaves of tender sprouts, causing them to curl and die. Spraying with a soap mixture, either formula 3, or a quarter of a pound of soap to one gallon of hot water is a sure remedy.

A scale insect, probably an *Aspidiotus* or *Mytilaspis*, has been reported from some sections as occuring on old or feeble trees, but I have not observed or investigated it. It can easily be destroyed by the use of formula 4, applying twice, at an interval of two weeks between sprayings, in October or February.

Tender shoots of the peach, especially those just starting from a bud or graft, are often seriously injured by various insects, usually termed pumpkin bugs, chinches, etc. These are the *Raphigaster hilaris*, green soldier bug; the *Metapodius femoratus*, and *Leptoglossus phyllopus*, leafy-legs. They puncture the juicy stems, which at once wilt as if scorched. The damage done is very annoying, and often quite considerable. The normal food of these bugs is probably some of the sunflower, thistle and golden rod family, for they seem to delight in assembling upon the plants when in bloom. Destroy these food plants, and spray tender shoots with formula 3, reduced to half strength, would probably be the best remedy.

Katydids, grasshoppers and crickets are troublesome in the early spring, before grasses and weeds have started, eating the foliage and girdling the young stems. In most cases clean culture, with a flock of chickens and guineas in the orchard, will prove a remedy, but if not available try *Formula 5.*

Paris green, one ounce; chopped grass, pea leaves or peach leaves, eight ounces; syrup enough to make the mass cohesive. Make into small balls and place under chips or boards near the trees. Every morning uncover, gather and burn the crickets, snapping beetles and other insects you will find. Of course, these should not be fed to poultry.

Termites, white ants, etc., only infest trees that are planted in proximity to stumps, or in fields covered with pine chips.

Burn stumps, roots, chips and scraps of wood before planting the trees, but if this cannot be done, clear away the decaying wood of the tree, and brush with solution No. 3.

The same remedy is available in the case of the black "fire ant," *Solenopsis xyloni.* This often attacks young shoots, or makes its colonies at the base of trees, and as it both bites and stings when disturbed, it is not to be despised, and can be destroyed with insect powder, fresh lime, kerosene emulsion, or by tearing open the hills and saturating the nests with hot water.

The *Rootknot.* This disease in nurseries, or with young trees, has done considerable damage, and is the source of some diversity of opinion as to prevention or cure.

The United States Bulletin No. 20, of the Entomological Department, at Washington, D. C., is a study of the cause and its habits, and its conclusions are:

The cause is a microscopic *nematode* worm. This is parasitic in a number of native plants along the Gulf coast.

The remedy is to plant non-infected trees in fresh or sterilized soil; to bud or graft into healthy, resistant stock, and use artificial and strongly potassic fertilizers.

JAS. C. NEAL, M. D.,
Entomologist.

ANNUAL REPORT OF EXPERIMENT STATION.

LAKE CITY, FLA, February 1, 1889.

To His Excellency Francis P. Fleming, Governor of Florida:

SIR—I have the honor to submit herewith a brief report of the operations of the Florida Experiment Station, in obedience to the provisions of the Act constituting said Station, approved by the President of the United States of America, March 2, 1887.

The changes in the Directorship and Staff occurring so near the time prescribed for this report, and the confusion incident thereto, have greatly hindered me, so that only a brief summary of the past and present experiments can be given.

I am, your Excellency, yours obediently,
JAS. P. DEPASS,
Director Florida Experiment Station.

In consequence of the lateness of the season when I assumed control of the Florida Experiment Station, at Lake City, Florida, but little has been accomplished in experimentation.

The disadvantages have been almost unsurmountable. Of the 100 acres of the Experiment Farm, forty or more are within the limits of Lake Alligator, thirty-five are yet original forest, and of the remainder nearly one-half is but partially cleared of roots and stumps.

I will plant from three to six trees of the leading varieties of peach, pear, plum, fig, apple, quince, nectarine and apricot, and a variety of grapes and strawberries, that may prove of value in Florida.

These will receive careful tests as to adaptability for this climate and soil, and the future will approve or reject the results.

A small nursery of pear and peach stocks has been planted for experiments in budding and grafting.

The experiments instituted by my predecessor with various forage plants, such as timothy, wheat, blue grass and a variety of clovers, have been continued, with very unsatisfactory results. Such plants as promise well will be given further time, and, when practicable, correct inference as to their value will be given in future Bulletins.

The seeds of many new forage plants, such as serradilla, vitches, lupines and pease have been planted, and ensilage plants, as teosinthe, millets and various sorghums are being tested as to growth and availability.

A small herd of Jersey cows are at the Station, and especial foods, with their effects upon milk and butter, will be a subject of future investigation.

Small areas of oats, corn, rice, cotton, peas, potatoes and sugar cane are being planted to ascertain the effects of varying quantities of fertilizers.

From the lack of suitable apparatus and rooms little has been done in entomological research, and until both are supplied, little should be expected in this department.

A collection of insects has been begun, and plans formulated for experiments with insecticides, in connection with the study of the life-history of insects that affect the tobacco plant, which is the subject selected for this year's work.

There being few published reports on the insects of Florida, and these not reliable, makes the study of the habits of those insects known to be destructive quite an undertaking, and one that will require the labor of several years at the least.

In Botany, it is contemplated to investigate the distribution and habits of our common weeds, and to ascertain their value in any degree for forage, land improvement, or medicinal uses.

Studies in cross-fertilizing will be carried on whenever practical, and efforts made to propagate new and valuable crosses of fruits, vegetables and plants suitable to Florida.

In the Department of Chemistry I submit the report of Professor J. M. Pickell, Ph. D.

"Soon after the passage of the Hatch Act, March, 1888, the Board of Trustees of the Florida State Agricultural College effected a temporary, or rather preliminary, organization of the Station. To my duties as Professor of Physics and Chemistry, at the College, were added those of Chemist at the Experiment Station. Owing to the small number of teachers at the College, I taught, in addition to the class in Chemistry, one in Latin and two in English Grammar. As soon as practicable, I was relieved of these classes, and, in April, 1888, was able to do some analyses for the Station. These were analyses of soils of the Station Farm, and some waters from

Lake City and Jacksonville, Florida. The former were published in Bulletin No. 3.

Up to this time, all Station work had been done in the College Laboratory. This consisted of two small rooms, and a very meager outfit of apparatus, the amount of which may be inferred when I state that the entire cost of chemicals, apparatus, gasoline machine and fittings, and gasoline, from November, 1884, to April, 1888, was $1,099.40.

The Laboratory had no supply of water other than as brought by hand in buckets.

In June, 1888, I was directed by the Board of Trustees to get up a plan for the building, which should serve as headquarters for the Director and Staff of the Experiment Station, as well as a Chemical Laboratory for the Station, and for Students' practice.

The building was to cost not less than $5,000 ($3,000 from the Experiment Fund and $2,000 from the College Fund).

I was engaged until late in the summer on the details of the plan. The contract was let toward the latter part of July, the building to be complete by November 15, 1888, but, owing to the epidemic and the many rainy days, it was not completed until the middle of December.

The necessity of having an assistant in Chemistry was shown to the Board of Trustees at their annual meeting in June, 1888, and Mr. John J. Earle, a recent graduate of the University of South Carolina, was employed at the opening of the fall term, October 5, 1888. Mr. Earle had received good training in Analytical Chemistry, and has proven a most industrious and competent assistant. During the fall and winter many requests for analyses of muck, soils, waters, etc., have been made, and, as far as practicable, the work has been done, and the results will be given in future Bulletins.

The new Laboratory is rapidly approaching completion, and will be the equal, for its size, of any in the South in equipment and personnel."

In conclusion, I may remark that it is the desire of the Director and his Staff to make this Experiment Station an eminently practical one in its results to the interests of Florida.

Respectfully submitted.

JAS. P. DEPASS,
Director.

FINANCIAL REPORT TO THE TREASURER OF THE UNITED STATES, FOR THE YEAR ENDING JUNE 30, 1888.

EXPERIMENT STATION OF FLORIDA.

1888.		CR.	
April	5—Paid	J. Kost, salary, March, $100; salary S. B. Mann, $15; Elmore Young, work, $3..	$118.00
May	3—	J. E. Young, sundries	59.75
	3—	J. Kost, expenses of Station, April	268.32
	11—	W. D. Barnes, Trustee, expense of attending at Lake City	10.50
	11—	E. S. Crill, Trustee, expense of attending meeting at Lake City	10.40
	11—	Dorr & Bowen, printing	1.85
	20—	A. E. McClure	115.00
June	8—	J. Kost, salaries, as per account, and printing Bulletin, No. 1	607.29
	8—	A. J. Russell, expenses attending meeting Trustees at Lake City	10.48
	11—	J. Kost, lumber and labor	170.84
	11—	J. E. Young, nails, etc	12.24
	11—	J. E. Young, advances for labor	93.74
	22—	H. H. Emmons, lumber and labor	268.75
	30—	Times-Union, publishing Bulletin No. 2	120.00
	30—	J. Kost, Director, salary, June	166.66
	30—	J. Kost, expenses of Station	25.87
	30—	W. H. Ashmead, salary, June	100.00
	30—	A. H. Curtiss, salary, June	50.00
	30—	G. T. Maxwell, salary, June	50.00
	30—	J. F. Appell, salary, June	50.00
	30—	Parker & Wood, tools	94.75
July	6—	J. E. Young, advance for labor	92.00
		Laboratory building	3,000.00
		Apparatus, chemicals, etc., for Laboratory,	1,835.00
		Office furniture for Director	250,00
		Water works and tax	750.00
		One two-horse wagon and mules	450-00
		Farm tools	75.00
		Implements on hand	600.00
		One wagon and harness	44.75
		A. H. Curtiss, salary for May	50.00
		G. Troup Maxwell, salary for May	50.00
		Carpenters' tools for Station	27.60
		Two cows for breeding	150.00
		Hogs for breeding	60.00
		Sheep for breeding	100.00
		Station Library	250.00
		Clearing land and fencing, etc	2,625.00
		Tiling	600.00
		Dairy and other stock	1,586.11
		Total	$15,000.00

1888	DR.	
March—	Appropriation General Government U. S	$7,500.00
April—	Appropriation General Government U. S	3,750.00
July—	Appropriation General Government U. S	3,750.00
	Total	$15,000.00

JAS. P. DEPASS, Director.

NO. 5.

(Bulletin No. 4 will be issued soon.)

BULLETIN

OF THE

EXPERIMENT STATION

—OF—

FLORIDA,

AT THE

STATE AGRICULTURAL COLLEGE,

LAKE CITY, FLA.

APRIL, 1889.

Rev. Jas. P. DePass, Director.

Agricultural College Job Print.

STAFF

Rev. Jas. P. DePass, Director,

Dr. J. C. Neal, Entomologist and Botanist,

Dr. J. M. Pickell, Chemist,

J. J. Earle, Assistant Chemist,

Lewis Thompson, Supt. Station Farm,

L. W. Plank, Supt. Sub-Station, DeFuniak Springs,

F. D. Pooser, Supt. Sub-Station, Ocala,

L. C. Washburne, Supt. Sub-Station, Ft. Myers.

ANALYSIS of FERTILIZERS.

Florida is the only State east of the Mississippi River that has no law for the analysis of commercial fertilizers. This State is, therefore, an open field for the sale of anything that anybody may choose to put upon the market under the name of "fertilizers." While it is not likely that manufacturers of well established reputation would go out of their way to produce an inferior article for this market, still, if in the process of manufacture, they should turn out a lot not up to the usual standard, Florida provides a market where this inferiority would never be discovered. However the matter may stand with the better class of manufacturers, dishonest ones, if there be any, can find here a place to carry on their operations unrestrictedly.

It will, of course, be impossible for the station to control this matter in the absence of a State law; it is, nevertheless, the purpose of the station to publish the results of analyses of fertilizers sampled from time to time in various parts of the State. Below are given a few such analyses:

KAINIT.

Wilcox Fertilizer Co., Savannah Ga., sampled at A. B. Hart's ware-house, Lake City, February.

	PER CENT.
Moisture at 150°	10.25
Potash	11.10
Salt	36.27
Sulphuric Acid (80)	23.07
Magnesia	11.53

KAINIT.

No mark on the bags; bought of W. A. Bours, Jacksonville, Fla.; sampled at the Experiment Station, Lake City, February.

	PER CENT.
Moisture at 150°	18.08
Potash	12.72
Salt	38.78
Magnesia	6.75
Sulphuric Acid	20,35

The fertilizing ingredient that determines the value of kainit is potash. The above samples agree fairly well in this ingredient with the usual guarantee. As is well known, the principal source of kainit is the Stassfurt Mine in Germany. This mine was formerly worked mainly for salt of which it contains vast quantities. Only within the last twenty or thirty years was the presence of potash in valuable quantities discovered. The unavoidable admixture of so large a per cent. of salt in kainit is an evil and renders great discrimination necessary in its use as a fertilizer. German agriculturists have discovered the fact that manures containing large amount of salt, although increasing the quantity of yield, degrade the quality of certain crops. Thus for example, salt diminishes the per cent. of starch in potatoes, of sugar in beets, and renders tobacco so poorly combustible as to ill fit it for smoking. On the other hand flax and grasses take well to salt. The German system of using kainit is, therefore, to apply it to these latter directly; then the following season, after the salt is assimilated by the soil, to plant to potatoes, beets, tobacco or other crops that especially need and are improved by potash. Another of their methods of utilizing the potash in kainit is to apply it first to the pea which is ploughed under; and the land then planted to such crops as they may wish. Until experiments have determined definitely the best method for Florida soils, it is undoubtedly safest to compost the kainit.

Paine's Florida Vegetable Food—Sample sent in by Capt. C. A. Finley, Lake City, February. No guarantee on sacks.

	PER CENT.
Moisture at 100°	17.50
Total Phosphoric Acid	16.53
Soluable Phosphoric Acid (in water)	10.17
Insoluble Phosphoric Acid (in citrate of Am'a)	2.27
Reverted Phosphoric Acid	4.09
Potash	.66
Ammonia	1.54

This fertilizer is very rich in phosphoric acid, poor in ammonia and very poor in potash.

BLOOD AND BONE.

Bought at Jacksonville, Fla., of Armour & Co., sampled at the Experiment Station, Lake City. No guarantee on sacks.

	PER CENT.
Moisture at 100°	9.75
Phosphoric Acid (total amount)	9.34
" " (Soluble in water)	.34
" " (insoluble in am'nia citrate	4.65
" Reverted	4.35
Ammonia	10.60

This is a highly ammoniated manure.

POT-AMMONIAC COMPOUND.

From J. J. Inglis & Co., Madison, Fla., sampled at the Experiment Station. No guarantee on sacks.

	PER CENT.
Moisture at 100°	15.75

Organic and volatile matter	53.10
Potash	1.97
Phosphoric Acid	6.15
Ammonia	2.53

This is a fairly good fertilizer.

MUCK, MARL AND SOILS.

Muck—Sent on from Island Lake, Orange county, Fla., by Miss Mary Lambert.

	PER CENT.
Moisture at 100°	46.10
Organic and volatile matter	48.87
Phosphoric Acid	.08
Potash and soda	.03
Nitrogen	1.20
Lime	[illegible]
Magnesia	[illegible]
Iron and alumnium oxides	[illegible]
Sand and insoluble matter	3 [illegible]

The per cent. of organic matter is large. That of sand, insoluble and useless matter small; and this may be considered an excellent quality of muck.

Marl—From the Turnbull Hammock, sent on by Mr. C. D. Sweet, Titusville.

	PER CENT.
Moisture at 100°	0.64
Organic and volatile matter	2.81
Phosphoric Acid	.37
Lime	43.17
Magnesia	.36
Iron and aluminum oxides	1.04
Potash	
Sand and insoluble matter	51.15

This marl might be profitably applied to land where lime is needed.

Soil (D)—Low Hammock, sample taken on the Experiment Station 100 yards or so from brink of lake. Depth taken about 5 inches

	PER CENT.
Moisture at 100°	0.59
Organic and volatile matter	2.50
Lime	.03
Magnesia	.02
Phosphoric Acid	.02
Potash and Soda	.10
Iron and Aluminum oxides	.13
Clay	.50
Sand	96.00

Soil (E)—Low Hammock, taken from near the same spot as above. Depth to which sample was taken about 2½ inches. Underlain by sand; but the sample judged by the eye seemed to contain little of that ingredient and much organic matter.

Moisture at 100o	3.87
Organic and Volatile Matter	14.43
Lime	.34
Magnesia	.13

Phosphoric Acid	0.70
Potash and Soda	.03
Iron and Aluminium Oxides	.49
Sand	80.55

The above two samples were taken in the virgin forest. Below is given the analysis of a soil and corresponding sub-soil, taken at the Station Farm from high, rolling hammock, for many years cleared and under cultivation.

	PER CENT.
Moisture	0.51
Organic and Volatile Matter	1.27
Lime	,06
Magnesia	.03
Phosphoric Acid	.07
Potash and Soda	.0 9
Iron and Aluminum Oxides	33
Clay	2.77
Sand	96.02

SUBSOIL

Moisture	.28
Organic and Volatile Matter	.80
Lime	.03
Magnesia	.05
Phosphoric acid	.02
Potash and Soda	.09
Iron and Aluminum Oxides	,28
Clay	2.38
Sand	97.31

The striking feature of these soils is the large amount of sand. If they are compared with each other with reference to the amount of moisture and organic matter they contain, thus:—

Moisture	0,28	0.51	0.59	3.87
Organic Matter	.80	1.27	2,50	14,43
Sand	.97,00	96,00	96.00	80,55

it will be observed that the amount of moisture increases as the amount of organic matter increases, and that it is less, the greater the amount of sand. Nothing is of greater importance in the treatment of the sandy soils of Florida than keeping them well supplied with abundance muck or other vegetable matter. This treatment, not to speak of its fertilizing value, increases greatly the capacity of the soil to retain moisture and withstand drought.

Directions for taking samples of soil, water and fertilizers.

Great care should be taken that the sample represents a *fair average* of the substance to be analyzed, and that they be put into *clean* vessels.

SOILS.

In taking samples of soil avoid fence corners, and spots that have been enriched above the average by droppings from animals, decayed logs, stumps, etc. Scrape away the top trash, leaves or mould, make with a spade a hole five or six inches square. The hole should be sunk perpendicularly to the surface. From one side of the hole take with a spade a slice two or three inches thick and down to a depth equalling the depth of the soil. This will usually be from five to twelve or fifteen inches. The point at which the soil ends and where the sub-soil begins is usually pretty well marked by difference in color or texture of the soil. Take several samples in this way from different parts of the field, put them together, thoroughly mix and from the mixture make up a sample, for analysis, of two or three pounds. In a similar way take samples of the sub-soil from the same holes from which the soil samples have been taken. A pint or quart fruit jar is the best and most convenient vessel for holding sample. Each sample should have a label, telling where taken, the nature of the land—pine, high or low hammock, etc.

FERTILIZERS.

Open about every tenth sack, or package of the lot to be sampled; take from the interior as well as from the ends of each, a pound or so; mix the portions from the different sacks thoroughly in a clean; dry box, and from the mixture fill a quart fruit jar and seal so as to be air-tight. The operation of sampling should be gone through with as quickly as possible and in such a place and in such a manner as to prevent the fertilizer from either losing or taking on moisture. Label with name and address of sampler brand of fertilizer, manufacturer's name and address.

WATER.

Samples of water should always be put into glass bottles or demijohns. Too great care cannot be had to thoroughly cleanse the bottles, and to use fresh, clean stoppers. To this end, after the vessel has been thoroughly cleansed, it should be rinsed a half dozen times or more with water from the same source as that to be analyzed. The sample should then be put in, immediately corked and sealed with wax. Corks should, before using, be soaked for several hours in frequently changed water from the spring or well to be analyzed. In taking sample avoid getting mud, sand, and other foreign matter. Not less than two gallons should constitute a sample.

If there is any gas in the water, proceed as follows to catch the gas: Fill a demijohn with water, cork it, insert and uncork with mouth under water; if held in this position the gas will rise and take the place of the water in the demijohn. When full of gas, cork while under water, and seal with wax.

J. M. PICKELL, Professor of Chemistry and Physics,
Station Chemist.
JOHN J. EARLE, Assistant Chemist.

NOTE. All samples of fertilizers, soils, water, cereals and fruits, if sent prepaid, are analyzed free to the sender on application to the Director, Rev. Jas. P. DePass, Lake City, Fla.

The unfinished and incomplete condition of the laboratory till now, has heretofore crippled and limited chemical investigation.

THE HATCH ACT.

AN ACT TO ESTABLISH AGRICULTURAL EXPERIMENT STATIONS IN CONNECTION WITH THE COLLEGES ESTABLISHED IN THE SEVERAL STATES UNDER THE PROVISIONS OF AN ACT APPROVED JULY 2ND, 1862, AND OF THE ACTS SUPPLEMENTARY THERETO.

SECTION 1. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under direction of the college or colleges, or agricultural department of colleges, in each State or Territory established, or which may hereafter be established, in accordance with an act approved July 2d, 1862, entitled "Act donating lands of the several States and Terrtories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "Agricultural Experiment Station:" *Provided*, That in any State or Territory in which two such colleges have been or may be so established, the appropriation hereinafter made; to such State or Territory shall be equally divided between such colleges, unless the Legislature of such State or Territory shall otherwise direct.

SEC. 2. That it shall be the object and duty of said Experiment Stations to conduct original researches or experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops. the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the compositon and digestibility of the different kinds of food for domestic animals; scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States and Territories.

SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States Commissioner of Agriculture to furnish forms, as far as practicable, for the tabulatin of results of investigations or experiments; to indicate from time to time such lines of inquiry as to him shall seem most important and in general to furnish such advice as will best promote the purposes of this act It shall be the duty of each of said stations, annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located, a full and detailed report of its operations, a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the Commissioner of Agriculture, and the Secretary of the Treasury of the United State.

SEC. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the station will permit. Such bulletins or reports, and the annual reports of said stations shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the Postmaster General may from time to time prescribe.

SEC. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments and printing and distributing the results as hereinbefore prescribed, the sum of $15.000 is hereby appropriated to each State, to be specially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the treasury proceeding from the sales of public lands, to be paid in equal quarterly payments on the first day o January, April, July, and October in each year, to the treasurer or other officer duly appointed by the governing boards of said college, to receive the same, the first payment to be made on the first day of October, 1887: *Provided, however*, that out of the first annual appropriation so received by any Station an amount not exceeding one-fifth may be expended in the erection, enlargement, or repair of a building or buildings, necessary for carrying on the work of such station; and thereafter an amount not exceeding five per centum of such annual appopriartion may be so expended.

SEC. 6. That whenever it shall appear to the Secretary of the Treasury, from the annual statement of receipts and expenditures of any of said stations, that a portion of the preceeding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SEC. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States or Territories in which they are respectively located.

SEC. 8. That in States having colleges entitled under this section to the benefits of this act, and having also agricultural experiment stations established by law separate from said colleges, such States shall be authorized to apply such benefits to experiments at stations established by such States; and in case any State shall have established, under provisions of said act of July 2nd aforesaid, an agricultural department or experimental station in connection with any university, college or institution not distinctively an agricultural college or school, and said States shall have established or shall hereafter establish a separate agricultural college or school which shall have connected therewith an experimental farm or station, the Legislature of such State may apply in whole or in part the appropriation by this act made to such agricultural college or school; and no Legislature shall, by contract express or implied, disable itself from so doing.

SEC. 9. That the grants of moneys authorzed by this act are made subject to the legislative assent of the several States and Territories to the purposes of said grants: *Provided*, That payments of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of the Legislature meeting next after the passage of this act shall be made upon the assent of the Governor thereof, duly certified to the Secretary of the Treasury.

SEC. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the treasury to any or all the States or institutions mentioned in this act; but Congress may at any time amend, suspend or repeal any or all of the provisions of this act.

Approved March 2, 1887.

SPECIAL NOTICE.

The Experiment Station purposes examining the potable waters of Florida as to their healthfulness and medicinal properties, and also other waters as to their fitness for irrigation and other industrial uses.

The object being to benefit the largest possible number of the citizens of the State, preference in analysis will be given to those waters which concern and effect communities at large.

It is especially desirable to investigate water which is known to have caused sickness. It is also desirable to know accurately the constituents of water used for irrigation, and to study carefully the effect on plant growth.

No fees will be received, or charges made, for any analyses that the Station will undertake; and the right is reserved to refuse to analyze waters which would redound to the pecuniary benefit of private parties or corporations only, and which, therefore, are not within the scope of the work of the Station.

No water will be analyzed unless the following directions for sampling and forwarding are strictly followed :—

DIRECTIONS FOR SAMPLING.

1. The sample must be put into glass vessels, best demijohns.

2. *The vessels must be absolutely clean.* To this end they should be repeatedly washed and scoured with clean sand. After they have thus been thoroughly cleansed, they should be rinsed a half dozen times or more with water from the same source as that to be analyzed. No old cork or other source of contamination, should be left in the vessels. Corks used in stopping should, if possible, be perfectly new and fresh and, even then, should be soaked in frequently changed water of the kind to be analyzed ; if old corks have to be used, boil and soak them repeatedly in water taken from the well or spring to be analyzed. When the vessel and cork have thus been thoroughly cleansed, the sample should be taken directly from the well or spring, and immediately corked and sealed with wax. Avoid getting sand, mud, trash or other impurities.

3. As little time as possible should intervene between the time of sampling and of analysis. It would be well, therefore, to consult the Station as to when the analysis can be made, before taking and forwarding the sample.

4. Express, or other expenses of transmissal, must be pre-paid.

5. The sample should always be labeled with the name and address of the sender ; and a letter should be sent along, giving all possible information in regard to the water, the nature of the locality, situation of well or spring, etc., etc.

6. *Not less than two gallons* should *be sent.*

All applications for analyses should be made to the Director of the Station.

By order of
Jas. P. DePass, Director.

J. M. Fickell, Chemist.

STATE AGRICULTURAL COLLEGE.

LAKE CITY, FLORIDA.

FACULTY.

F. L. KERN, President,
Professor of Logic, Elocution, Psychology and Natural Science.

ALEXANDER Q. HOLLADAY,
Professor of History, Literature, English and Latin.

Capt. L. H. ORLEMAN, U. S. Army,
Professor of Mathematics and Commandant of Cadets.

GEORGE CHATTERTON, Jr.
Professor of Mechanical Engineering and Industrial Arts.

H. P. BAYA, Assistant Professor.

J. N. WHITNER, Professor of Greek, Agriculture and Horticulture.

J. M. PICKEL,
Professor of Chemistry and Physics.

J. J. EARLE, Assistant Professor in Chemistry.

Jas. P. De PASS,
Professor of Pomology.

J. C. NEAL,
Professor of Entomology and Veterinary Pathology

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OHIO AGRICULTURAL EXPERIMENT STATION
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COLUMBUS, O.

Bulletin No. 6,

—OF THE—

Experiment Station

—OF—

FLORIDA.

—AT THE—

STATE AGRICULTURAL COLLEGE,

Lake City, Fla.

JULY, 1889.

REV. JAS. P. DEPASS, DIRECTOR.

JACKSONVILLE, FLA.:
DaCosta Printing and Publishing House.
1889.

STAFF:

REV. JAS. P. DePASS, DIRECTOR.
DR. J. C. NEAL, ENTOMOLOGIST AND BOTANIST.
DR. J. M. PICKELL, CHEMIST.
J. J. EARLE, ASSISTANT CHEMIST.

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INTRODUCTION.

In issuing Bulletin No. 6, I have confined its matter mostly to the Chemical Department.

The Chemists have worked to their utmost capacity, and still have on hand many samples of mucks, soils, clays, waters, and fertilizers that in due time, and as soon as possible, will be analyzed and the results given in future Bulletins. All who have sent samples, and those who may yet send them, will please be patient and bide their time.

The Experiment Laboratory is as complete as any in the country, but is not as large as many, and hence cannot do the work as rapidly. With some people the opinion prevails that an analysis requires but a few minutes, when, really, to determine properly the composition of a soil or fertilizer may require several days.

The attention of our farmers is especially called to the Trifolium Incarnatum, or Crimson Clover. This is exceedingly promising as a forage plant, and I would urge that it be generally tested in Florida, as suggested by the Botanist.

A number of experiments with general field-crops, grasses and fruits have been begun, and some, despite the protracted drought of May, have developed points of interest, that will be treated upon in succeeding Bulletins.

The Station Farm will soon be in a condition that will enable us to test, more successfully than ever, anything of interest to our farmers, especially the value of various systems of irrigation.

NOTE CAREFULLY.

Persons desiring information, or analyses from the Experiment Station, should address the Director, at Lake City, Fla. Bulletins are sent free to anyone in Florida applying for them. Write me, giving legibly, Name, Post Office and County, for my mailing list. Omit the title of your grove or farm, and write the second time if a Bulletin does not reach you promptly. Please send specimens, with full descriptions, of any grasses, cereals, fruits, etc., that promise to be valuable for testing at the Station.

Samples of *all* insects, sent in small *tin* boxes, are especially requested by the Entomologist, who will promptly answer any inquiry. Never send insects in paper boxes.

JAS. P. DEPASS,
Director.

TRIFOLIUM INCARNATUM.

Since the establishment of the Florida Experiment Station, seeds of many forage plants have been sown in the hope of finding something that would give either winter pasture or ensilage. The results have not been very satisfactory, the usual drought that occurs in April or May in Florida, having proved fatal to nearly all plants that have survived to that date.

No perennial plant has been tried that has proved of any value, but an annual clover—*Trifolium Incarnatum L.*, the long-headed or Crimson Clover—a native o Italy, probably, has for two seasons given promise of excellent results, enough to justify an extended trial over the State, especially the clay lands of the northern and central tier of counties. Its annual habit is somewhat of a drawback, but its rapid growth, and accommodative ability to endure the peculiar climatic conditions of Florida, render it worthy of study as a prospective winter pasture plant, the coming ensilage material, or a plant for dry forage.

The growing interest in ensilage, and the conviction that this will solve the question of better cattle in Florida, more milk and butter, with better farms, better gardens and better health as results, makes this clover especially interesting at this juncture.

Experiments made at the Wisconsin Agricultural Experiment Station, have shown that ensilage made with well-ripened Red Clover, *Trifolium Pratense*, was "eagerly eaten by cattle," preserved well, that it was not necessary to run it through a cutting machine, and the expense of filling the silo was very light.

This, to our average farmer, who is deterred from trying ensilage by the cost of the usual machinery deemed essential, is no slight advantage the clover has over corn, millet, and other crops.

If the Crimson Clover can be grown cheaply on our poor lands by the use of mineral fertilizers, its habit of ripening during the dry season of May will enable our farmers to put it unhurt into silos, and avoid the usual wasting of fodder that is so prevalent in June and July, giving a succulent food during the winter, hitherto not available, or by curing it obtain a superior hay that chemically is little inferior to the average of eleven clovers that are in common use over the world. These analyze in 100 parts of the dry plant:

18.68 parts flesh making principles.
3.76 parts fat " "
41.48 parts heat " "

The Crimson Clover, in 100 parts, dry plant:

16.60 parts flesh making principles.
3.73 parts fat " "
37.50 parts heat " "

The addition to the Crimson Clover, of a small ration of wheat bran, corn, or cotton seed meal, will bring it to the standard, or nearly so, of other forage plants of this class.

Of course, in Florida, where other clovers will not grow well, is this Trifolium Incarnatum especially recommended.

October 29, 1888, a small plot of old worn out land was fertilized at the rate of one ton to the acre, of well rotted stable manure. This was spread broadcast and plowed in. November 10, shallow furrows, 18 inches apart, were opened, and the seed of the Crimson Clover—15 pounds to the acre—thinly scattered, and covered with one furrow. The clover came up fairly well, and by February 1st the ground was hidden by its growth. In March it was plowed out with a "bull-tongue," and when weedy it was hoed out.

The rabbits were very destructive to the tender growth, and many plants were ruined by them, as well as by wire-worms (*Elaters*), cut-worms (*Agrotis*), and various grasshoppers.

Despite these enemies, in May it presented a beautiful sight; the crimson heads contrasting finely with the abundant dark-green foliage.

By the first of June the stems averaged two feet in height, and when cut it yielded at the rate of 7½ tons of green feed per acre, or nearly two tons of dry hay, which was greatly relished by the cattle at the Farm.

No doubt, if some potash fertilizer had been used, and the seeds planted later in November, it would have given better results, and experiments in this direction will be made this coming Autumn.

As a bee-pasturage, it promises well, and my observations indicate that it will, in great measure, supply the place of the clovers of the North, which are so valuable in honey producing qualities.

TEXAS BLUE GRASS.

(*Poa Arachnifera.*)

The introduction of this grass has been very general over Florida, with the hope that at last a pasture grass had been found. Several years have elapsed, and it is still on trial, with some uncertainty as to its merits.

The seeds have little vitality, so small a percentage germinating, that it is hazardous to depend upon sowing broadcast, while planting the sets involves such a prodigious amount of labor that it effectually debars its use over large areas.

A small plat set in this grass in 1888, and well fertilized, grew finely, and in May, 1889, seeded freely despite the ravages of insects. This plat has been allowed to stand to see if it will seed itself, and also to note its resistance to the invasions of the Nut-grass, Sandspurs, Compass-weed (*Diodia*), and Crab-grass, weeds that grow so freely on old and pasture lands in Florida. Till these experiments and others are concluded, it is not advisable to give opinions that will be positive.

J. C. NEAL,
Botanist Florida Exp. Station.

Department of Chemistry.

J. M. PICKELL, *Chemist*,
J. J. EARLE, *Assistant Chemist.*

SOME FLORIDA WATERS.

31 ARTESIAN WATER.

FERNANDINA, FLA.

Depth of well about 600 feet.

Analysis:

Silicic Acid	2.30	grains	per	English	gallon
Carbonate of Lime	2.16	"	"	"	"
Sulphate of Lime	15.36	"	"	"	"
Carbonate of Magnesia	9.01	"	"	"	"
Chloride of Potash	0.59	"	"	"	"
Chloride of Soda	3.88	"	"	"	"
Total residue,	33.29	"	"	"	"

Sulphuretted Hydrogen, considerable.
Free Ammonia, trace.
Albuminoid Ammonia, 0.05 parts per million.

32. ARTESIAN WATER.

SARASOTA, FLA.

Analysis:

Silicic Acid	2.26	grains	per	English	gallon
Carbonate of Lime	8.80	"	"	"	"
Magnesia	3.66	"	"	"	"
Oxides of Iron and Aluminum . . .	0.15	"	"	"	"
Chloride of Soda and Potash	15.29	"	"	"	"
Sulphuric Acid	10.80	"	"	"	"
Chlorine	4.72	"	"	"	"
Solid residue	39.20	"	"	"	"

Sulphuretted Hydrogen, considerable.
Free Ammonia . . . . 0.16 parts per million.
Albuminoid Ammonia. 0.06 " " "

27. LAKE ISABELLA WATER.

LAKE CITY, FLA.

Analysis:

Silicic Acid	0.08	grains	per	English	gallon
Sulphate of Lime	0.61	"	"	"	"
Sulphate of Magnesia	0.33	"	"	"	"
Chloride of Soda	1.56	"	"	"	"
Chloride of Potash	0.37	"	"	"	"
Solid residue	2.97	"	"	"	"

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28. WATER FROM LAKE CITY WATER-WORKS.

Drawn at the College May 22.

Analysis:

Silicic Acid	0.08	grains	per	English	gallon
Oxides of Iron and Aluminum	0.33	"	"	"	"
Sulphate of Lime	0.59	"	"	"	"
Sulphate of Magnesia	0.36	"	"	"	"
Chloride of Soda	1.60	"	"	"	"
Chloride of Potash	0.11	"	"	"	"

[July 9.]

Free Ammonia	0.05	parts	per	million.
Albuminoid Ammonia	0.14	"	"	"

[July 23.]

Free Ammonia	0.02	"	"	"
Albuminoid Ammonia	0.17	"	"	"

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29. COLLEGE WELL WATER.

LAKE CITY, FLA.

Depth of well about 15 ft.

Sample taken May 27.

Analysis:

Silicic Acid	0.19	grains	per	English	gallon
Oxides of Iron and Aluminum	0.08	"	"	"	"
Sulphate of Lime	0.42	"	"	"	"
Sulphate of Magnesia	0.17	"	"	"	"
Chloride of Magnesia	0.08	"	"	"	"
Chloride of Soda	0.42	"	"	"	"
Chloride of Potash	0.12	"	"	"	"
Solid residue	1.48	"	"	"	"

[May 25.]

Free Ammonia, none.

Albuminoid Ammonia	0.03 parts per million.

30.

AN OLD WELL.

LAKE CITY, FLA.

Depth about 20 ft.

Sample taken June 3.

Analysis :

Silicic Acid	0.25	grains per English gallon
Carbonate of Lime	3.93	“ “ “ “
Carbonate of Magnesia	1.61	“ “ “ “
Sulphate of Lime	2.79	“ “ “ “
Chloride of Soda	10.35	“ “ “ “
Chloride of Potash	1.32	“ “ “ “
Solid residue	20.25	“ “ “ “
Free Ammonia	0.18	parts per million
Albuminoid Ammonia	0.18	“ “ “

33

WELL WATER.

SAN ANTONIO, FLA.

Depth of well 17 ft.

Sample sent on May 30, tested July 9.

Analysis :

Free Ammonia	0.03	parts per million
Albuminoid Ammonia	0.20	“ “ “

34.

CLEAR WATER LAKE.

SAN ANTONIO, FLA.

Sample sent on May 30, tested July 9.

Analysis :

Free Ammonia	0.03	parts per million
Albuminoid Ammonia	0.26	“ “ “

36.

DRIVEN WELL.

At Perry Bros. & Taylor's, Lake City, between side walk and road.

Depth about 20 feet.

Sample taken and tested July 23.

Analysis :

Free Ammonia	0.03	parts per million
Albuminoid Ammonia.	0.01	“ “ “

37. WATER FROM MUD PUDDLE

in road four or five feet from the above named driven well.

Sample taken and tested July 23.

Before testing, the water was passed through filter paper till it became clear.

Analysis:

Free Ammonia	0.18 parts per million.
Albuminoid Ammonia.	0.92 " " "

INTERPRETATION OF THE FOREGOING ANALYSES.

Good health of both man and brute depends on no other thing more, perhaps, than on pure, wholesome water. The purest form of water in nature is rain water; but even this is not entirely free from foreign matter. In its descent through the air it collects more or less of dust, and absorbs small quantities of gases from the atmosphere; still, when properly caught and preserved, it constitutes the purest form of drinking water.

The impurities in water are of two kinds—those held in suspension and those held in solution. The former are visible to the eye, and can be removed by straining or filtering.

SOLID RESIDUE.

If water, which has long been in contact with the earth, be evaporated to dryness, a solid deposit will be left. The amount of this solid residue varies with different waters, or rather with different soils with which the water has been in contact. The constituents of this residue are commonly silica, carbonate of lime, magnesia, iron (also sulphates), chlorides of soda, potash, etc. Wanklyn, an authority on water analysis, lays down the rule, "that if the solid residue do not exceed 30 or 40 grains per gallon, the amount of solids affords no reason for rejecting the water for domestic use."

HARDNESS.

Water is said to be hard or soft according as it requires much or little soap to form a lather. If it contains carbonate or sulphate of lime or magnesia, the lime and magnesia form insoluble salts with the stearic and other acids of the soap; these salts appear as white precipitates, giving a milky look to the water. So soon as the lime and magnesia are consumed, a lather is formed. If the hardness results from carbonates it can be removed by boiling or by adding milk of lime, and is called *temporary*; if it results from sulphates, it cannot be so removed, and is called *permanent*. All the above waters are *soft*—most of them remarkably so.

AMMONIA.

Not only mineral, but vegetable and animal matter may be held in solution. Water thus contaminated is not fit for use, as it may cause diarrhœa, cholera, typhoid fever and other epidemic diseases. Albumin is a constituent of flesh, nerves and tissues of all animals. Nitrogen is one of the components of albumin. If water, which contains albuminous matter, be boiled with an alkaline solution of potassium permanganate, nitrogen in combination as ammonia will be given off. This is called *albuminoid ammonia*, and its quantity is in direct proportion to the quantity of albumin present in the water. Wanklyn, above referred to, divides water into three classes:

I.	Of extraordinary organic purity, containing . . .	0.00 to 0.05
II.	Good drinking water	0.05 to 0.10
III.	Suspicious, above	0.10

parts of albuminoid ammonia per million.

If a water contains as much as 0.15, it ought, he says, to be condemned absolutely. Applying this rule to the above waters Nos. 30, 33, 34, 37, are to be regarded as very bad; 29, 31, 32, 36, good, to extraordinarily pure; 28, suspicious.

A short study of these waters in detail will be of practical benefit.

Of No. 30 is very bad; it is an old well about 20 feet deep, recently boxed up with new plank. Near it are three privies, distant from it twenty, twenty-five and sixty feet, respectively. It has not been used for drinking for months, its proprietor suspecting its character.

No 29 is organically very pure. This well has been in use about two and a half years, is walled up with plank. It is situated close to the College barracks on sloping ground, and the drainage is around, past and away from it.

Of No. 33, which is very bad, Dr. J. S. Corrigan, who sent on the sample, says "it is, dug in the sand about five feet to clay and then continuing about twelve feet in the clay, making 17 feet deep in all. When the dry season comes the water in the well sinks till but two or three feet in depth are left, and at such times it is likely to have a slightly opalescent appearance. Ordinarily it is as clear as the sample. I am under the impression that water having this opalescent appearance well marked is not desirable for drinking. I have seen a good deal of fever and diarrhœa present where such milky looking water was used, but this may be a coincidence depending on other influences and not in consequence of using the water. In our own experience, some diarrhœa appears to have been occasioned a few weeks before sending you the sample, by the use of this water. At this time also some dead frogs were found in and taken from the well, a common occurrence with ordinary wells."

Of No. 34, which, according to the ammonia test, is as bad as 33, the same gentleman says, "that it is from a lake, the water of which is beautifully clear, and the supply seems to depend on springs to a great extent. The lake is surrounded by hills and receives the rainfall of the few miles immediately adjoining, or rather a part of it. The use of the water for drinking seems unattended by any bad results."

No. 36 is, as said above, a well driven in the main street of Lake City. It is about 20 feet deep and passes through a soft stone (sand stone, perhaps). It has long been a favorite with the people in the neighborhood. The water pumped from it forms a puddle a few feet away. There is no drainage from the well. The rainfall for many yards around must either soak into the earth or be dried up by the sun. The water from the puddle is extraordinarily impure, whereas that from the well is of remarkab'e purity. Either none of this surface water gets into the well, or else, in its passage through 50 feet of earth to enter the bottom of the pipe, is freed of its impurities.

The water of the two artesian wells are of excellent quality. Owing to the fact that it was not possible to operate at the wells, no determination of the quantity of hydrogen sulphide was made; but judging from qualitative tests made in accordance with directions sent out from the laboratory, the quantity of that gas must be very considerable. The presence of ammonia in these wells, though the quantity is too small to indicate contamination, is remarkable. Professor Mallet, of the University of Virginia, found in water from the artesian well at Charleston, S. C.:

Free ammonia	0.30;	0.020 parts in a million
Albuminoid ammonia	0.04;	0.035 " " "

The depth of this well is 1,974 feet.

PRACTICAL SUGGESTIONS.

Too great care cannot be had in locating a well. It should not be in proximity to the stable, pig-stye, cow-lot, privy, nor even too near the kitchen. If possible it should be on a spot higher than the surrounding ground, so that the flow of surface water will be from it. In no case should water be permitted to get into it from above. It should be cemented from top to bottom and kept securely closed. In the sandy soil of Florida, driven wells are, without doubt, the safest from all surface contamination; they should, however, be sunk deep, as much as 20 to 25 feet, or more.

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38. GYPSUM.

Sent on by Mr. A. L. Eichelberger, Ocala, Fla. Four samples marked A. B. C. D. The deposit lies on the banks of the Withlacoochee river, on the surface, and is six or eight acres in extent and two to three feet in depth. The specimens sent on are of a yellowish or cream color, consist of granules and clumps the size of a pea. On a hasty glance it might be taken for coarse sand, but closer inspection —rubbing between the fingers—immediately discloses the fact that it is but to a small extent sand. Under the microscope, the particles, or granules, are seen to be transparent fragments of crystals.

A portion taken from each sample, so as to get a fair average of the whole, analysis, as follows:

Analysis:

Moisture (in air-dry product) at 130° . . . . 18.79 per cent.

The product after all the water is driven off contains:

Sulphuric Acid	45.55	per cent.
Lime(Ca o)	36.49	" "

Equivalent to

Calcium Sulphate	77.45	" "
Calcium Carbonate	8.23	" "

The remaiming 14.33 per cent. consists mainly of sand, with traces of phosphoric acid, very small quantities of iron oxide, magnesia, and chlorides of potash and soda.

Each of the four samples, when heated to 110° to 120° Centigrade, (230° Fahrenheit), falls into a powder, which, when treated with water, hardens, or sets, quite well, showing that this gypsum makes a fair quality of Plaster of Paris. Its color, however, is yellowish.

COMPOSITION, OCCURRENCE AND USES OF GYPSUM.

Gypsum occurs in various forms, viz: well defined transparent crystals which are capable of being split into thin laminæ; as fibrous gypsum with satin lustre; as white or light colored fine grain, compact mass, known as alabaster. There are many other varieties. Massive gypsum occurs in abundance in New York, Ohio, Illinois, Virginia, Tennessee, Arkansas, Nova Scotia; also in Europe. Beautiful specimens o' ababaster are found in the Mammoth Cave, Ky. It is extensively imported from Nova Scotia into the United States.

COMPOSITION.

Pure gypsum consists of 79.07 per cent. of sulphate of lime and 20.93 per cent. of water. When heated gently (a few degrees above the boiling point of water), it gives up its water and falls to a fine powder. This powder is known as Plaster of Paris which finds such extensive use in the arts. When brought in contact with water, it has the power of again uniting with water. When this union takes place, it "sets," or hardens. Instead of pure water, lime-water a solution of gum-arabic, or of alum (20 ounces to 9 pounds of water), or 1 part borax to 9 parts water, may be used. An artificial stone is obtained from gypsum by burning and immersing in water, exposing to air and again immersing in water. Treated with paraffine and coloring matter, a product is obtained from which cheap "Meerschaum" pipes are made.

The term, "burnt gypsum," is misleading. The temperature at which the best Plaster of Paris is obtained, is a little above the boiling point of water, 110°—120° by the Centigrade, or 230°—248° by the Fahrenheit thermometer. If heated above 204° Centigrade or 399° Fahrenheit, it loses the power of setting with water and is said to be "over-burnt."

GYPSUM AS A FERTILIZER.

The use of gypsum as a fertilizer dates back to the Greeks and Romans. Formerly enormous quantities were used in Germany on red clover. It is extensively used in this country now. Many experimenters have sought to discover the cause of its action as a fertilizer. It contains calcium and sulphur, both of which are indispensable to plant growth; but very few soils are deficient in these elements. Moreover, when applied to soils abounding in these elements, the plaster has its usual effect, showing that its value does not consist in supplying a *deficiency* of lime or sulphur. The idea obtains that gypsum absorbs ammonia from the atmosphere. But there is very little ammonia in the atmosphere to be absorbed. If the action of the gypsum were due to this, then that action would be expected to be somewhat uniform; but there is no fertilizer so capricious. The conclusion reached by many experimenters, working independently, is that gypsum is an excitant rather than a direct fertilizer; it acts chemically on the insoluble silicates of the soil. In this action the calcium of the gypsum is exchanged for the potash of the silicate, and sulphate of potash, an exceedingly soluble salt, is formed. Thus, potash, which is locked up from the plant, is rendered available. It follows from this, that it would be of little use to apply gypsum to a soil deficient in potash.

Storer, an authority, in his work on agriculture, recently published, says: "Gypsum has, in fact, often been found useful on new lands of certain kinds and qualities, and on old fields which have been cropped and fertilized in a way which was not perhaps wholly judicious. It is often of great use in regions where wheat is grown in alternation with clover, since by encouraging the growth of clover it acts as a manure for wheat." "But it is none the less true that gypsum is a fit manure neither for poor land nor for regions where high farming is practiced. It has found place only in districts where the methods of farming were simple, and, so to say, backward, and is really a fertilizer of times that are past. Wherever there is profit to be got from high farming, gypsum would usually be found to be a much less efficient fertilizer than potassic manures, used either as such or in conjunction with lime or with leached ashes. Of course gypsum can, and does, supply plants with lime and sulphur in cases where the plant needs more of these things than can be found already in the soil; but, considered as a manure of direct action, it has infinitely less significance than bone meal, guano, super-phosphate of lime, and the like, which actually give to the plant substances which are lacking in the soil."

GYPSUM AS A PRESERVER OF DUNG.

Brought in contact with carbonate of ammonia in a *moist* state, gypsum forms carbonate of lime and sulphate of ammonia. This latter compound is a non-volatile salt, and does not give off its ammonia to the air. Gypsum strewn in horse-stalls prevents the escape of ammonia. Storer gives the results of experiments made with stall-fed sheep to determine " how much of the nitrogen in the fodder was retained in the manure according as one or another of the preservatives was scattered upon it : "

No Preservative	71 to 82 per cent
0.10 kilos gypsum to each sheep, per day	88 to 90 " "
0.08 " kainit " " "	84 to 94 " "

(A kilo is about two pounds.)

He calls attention to the fact, however, that there is a loss both of dry matter and of nitrogen in manure that is kept in compost with gypsum or kainit. In the case of kainit the loss, after three months, has been found to be 20 per cent. of dry matter and 10 per cent. of nitrogen ; in the case of gypsum, 19 per cent. of dry matter and 32 per cent. nitrogen.

It should have been mentioned that experiments of Sachs show that gypsum checks the loss of moisture from the soil by evaporation through the leaves of plants.

[In view of the fact that considerable interest in gypsum is being manifested throughout the State, owing to the discovery of considerable deposits, it was deemed proper to give the above resume of the standing of that substance as a fertilizer.]

ASHES FROM THE CREMATORY, JACKSONVILLE, FLA.

Two samples were sent on, and at the request of the sender, they were mixed, and an analysis of the mixture made. One of the samples consisted almost wholly of sand, which reduced the average very much.

Analysis.	*I.*	*II.*
Moisture	1.71	12.00
Sand and insoluble matter	78.17	12.50
Organic and volatile matter	0.85	. . .
Oxides of iron and aluminum	6.63	0.83
Lime	7.38	34.44
Phosphoric acid	2.19	1.81
Potash	0.66	5.50
Magnesia	0.75	3.50

Under I is the analysis of the Crematory Ash.

Under II. is the average of seventy one analyses of Canada ashes, made at the Mass. Agricultural Experiment Station. This specimen of Crematory Ash has but little value as a fertilizer.

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40 PHOSPHATE.

Sample sent on by Mr. J. Hamilton Gillespie, Sara Sota, Fla.

These specimens are evidently fossil remain. The per cent. of phosphoric acid is high, 33.88.

25. FLORIDA HARDWOOD ASH } Sent on by Mr. W. R. Brown,
26. UNLEACHED CANADA ASH } Penn, Putnam Co., Fla.

Analysis:	(25)	(26.)
Moisture at 100°	1.62	10.85
Silica	10.51	11.38
Organics and volatile matter	0.69	3.33
Oxides of iron and aluminum	10.88	5.12
Lime	36.00	36.20
Magnesia	4.68	3.70
Phosphoric acid	4.40	1.72
Potash	1.93	2.44
Soda	2.08	1.84

HUMUS AND MUCK.

Numerous samples of muck have been sent on from various parts of the State. As yet we have not been able to analyze many of them, but hope during the winter to bring out on this subject a report which will serve as a guide to the farmers of the State. Muck is not generally rich in plant food. If it contains a large per cent. of vegetable matter, it is valuable for soils that are deficient in that ingredient, as it increases their power to absorb and retain moisture. But its use cannot supersede that of the usual manures. As to the means of forming an opinion of the quality of muck, the Connecticut Experiment Station has this to say:

"The quality of Swamp muck can be roughly inferred from the following considerations: When the swamp is a basin with a small outlet, or none, when the "wash" that enters it comes copiously from good rich soil; when the herbage that grows on it is tall and rank, when large quantities of forest leaves accumulate in it, we may safely assume that the muck will be relatively rich in plant food. It is from such deposits that the muck has been obtained, which is reported to have nearly equaled stable manure in fertilizing effect. On the other hand, when the wash into the swamp is scanty, and from coarse, poor soil, when the vegetation is mere moss, or a spare growth of sedge, and when large volumes of water flow through it and leach out its soluble matters, then it would be strange if the muck had any considerable active fertilizing quality. It may, nevertheless, even then, be very serviceable for *amending* poor, coarse, sandy or gravelly soils, but the amending must be followed up by real "manure" of the appropriate kind"

The plant food in muck is not thought to be available until it has been composted. Lime or stable manure are used with it in the compost heap.

Analyses of Muck.

	(21)	(22)	(23)	*Average.*
Moisture in air-dry humus	2.66	2.63	10.57	5.28
Organic and volatile matter	81.25	26.81	77.86	61.97
Insoluble mineral matter	14.86	69.38	10.21	31.48
Soluble mineral matter	1.23	1.18	1.36	1.25

These three specimens of humus were handed in for analysis by Mr. W. B. Knight, of Lake City. They were marked by him 1, 2 and 3, respectively. 1 and 2 (21 and 22) were taken on an elevation in open pine woods, with no indication of having been covered by water, unless remotely. The deposit extends over five or six acres. 3 (23) is from "rather a pond surrounded by cypress, in a wet time covered with water; in dry season, with ferns, grass, etc., peculiar to such places." The mineral constituent that might be available as plant food, is contained under "soluble mineral value," and is insignificant. Composted with lime or stable manure this humus might be profitably applied to lands deficient in vegetable matter.

By way of comparison, the average of the analyses of five samples of muck, made at the Maine Experiment station, is given below:

Organic matter in 100 lbs water-free muck	77.06
Mineral " " " " "	20.93

This mineral matter contained:

Lime,	(average)	15.03
Potash,	"	1.18
Phosphoric Acid	"	4.05

The value of the plant food contained in this muck was estimated to average not over $2.00 per ton.

BAT GUANO.

42. Sent on by Dr. P. Todd, Dunster, Fla.

Moisture at 100°	8.89
Organic and volatile matter	56.54
Silica	12.08
Oxides of iron and aluminum	7.32
Lime	4.48
Magnesia	0.04
Phosphoric acid	5.12
Potash and soda	0.55
Sulphuric acid	2.18

SOME SOIL ANALYSES.

The general public attaches undue importance to the analyses of soils. As to the utility of such analyses, chemists are divided, though the preponderance of opinion is, perhaps, against its practical worth. It is maintained, on the one hand, that it is well nigh impossible to get a sample that will represent a general average; that, even if this can be accomplished in regard to one field, the analysis would, quite likely, have no application to the next adjoining field; that soils differ so materially in their physical properties, it is impostible to establish any rule as to what constitutes a deficiency of any given element of plant food. On the other hand, it is maintained that in parts of the country there are vast tracts of land of practically uniform composition and character: that, if a sufficiently large number of analyses be made with all due care and accuracy, it is possible to establish for every species of soil, what constitutes a minimum of each element of plant food.

Prof. Hilgard, Director of the California Experiment Station, is the champion of this latter view. In an article, published in 1881, he gave the following, as the minimum percentages consistent with thriftiness of growth.

LIME.

0.10 per cent. in the lightest sandy soils; 0.25 per cent. in clay loams; 0.50 per cent. in heavy clay soils, and it may rise with advantage to one and two per cent.

PHOSPHORIC ACID.

In sandy loam, 0.10 per cent., when accompanied by a good supply of lime. The maximum found by him in the splendid table lands of Mississippi and Tennessee was 0.25 per cent.; in the best Mississippi bottom, 0.30. The highest per cent. that had come under his observation was 0.46 of one per cent., that was in a black prairie soil of Texas.

POTASH.

"The potash percentage of heavy clay upland soil and clay loams ranges from about 0.8 to 0.5 per cent., lighter loams from 0.45 to 0.30; sandy loams below 0.3, and sandy soils of great depth may fall below 0.1 consistent with good productiveness and durability. The highest percentage that he had ever observed was 1.3 per cent. and in the Mississippi bottom. Virgin soils with a less percentage than 0.06 he found deficient."

SULPHURIC ACID.

Even in the best soils the percentage of this ingredient is low; 0.02 to 0.04 is adequate, but frequently rises to 0.1.

IRON.

He puts 1.5 to 4.0 as ordinary percentage of ferric oxide, even in soils but little tinted. Ordinary loams from 3.5 to 7.0; highly colored red lands 7 to 12 and sometimes upward of 20.

To give an indication of the extent to which the foregoing deductions are, or are not, applicable to the highly sandy soils of Florida, three analyses of soils from the Station at Lake City are given below:

	I.	II.	III.
Moisture (at 100°)	3.87	0.59	0.51
Silica	80.55	96.80	96.02
Organic and volatile matter	14.43	2.50	1.27
Oxides of iron and aluminum	0.49	0.13	0.33
Lime	0.34	0.03	0.06

Magnesia	0.13	0.02	0.03
Phosphoric acid	0.70	0.018	0.07
Potash and soda	0.03	0.006	0.09
Clay	3.54	0.500	2.77

I and II are low virgin hammock, and are evidently rich, judging by the large oaks and dense undergrowth; III had been long under cultivation (not, however, within the last six or eight years) and was pretty well exhausted. I and II are the same soil and were taken within a few feet of one another, the diffrence being that I includes only the dark humus-rich top soil, whereas II was sampled down so as to include much of the underlying sand. The per cent, of lime, potash, and phosphoric acid in II is much less than the minimums given by Hilgard. It would be absurd to draw any conclusion from this one example; but should it ever, by comparison of numerous analyses, be found that an exceedingly low minimum percentage of plant food in the sandy and porous soils of Florida is consistent with high fertility, the result would not be surprising.

SOILS,

Sent by Mr. H. P. Walker, Auburndale, Fla.

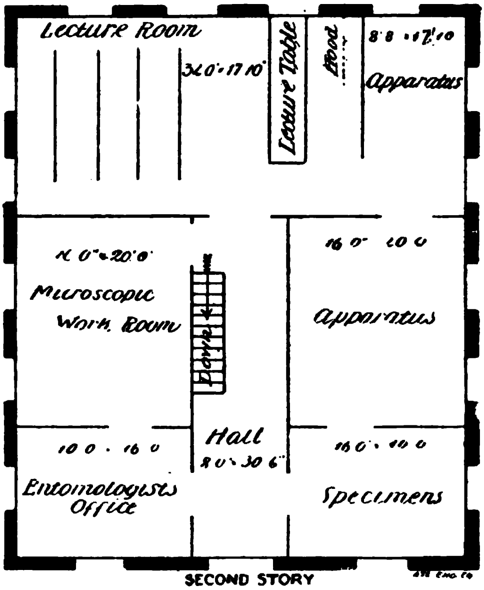
	(16)	(17)	(18)
Moisture at 100°	9.05	3.31	10.15
Sand	86.46	96.13	88.58
Organic and volatile matter	4.17	0.49	0.80
Oxides of iron and aluminum	0.08	0.02	0.40
Lime	0.10	0.007	0.008
Magnesia	0.03	0.001	0.003
Phosporic acid	0.01	0.005	0.005
Potash and soda	0.02	0.007	0.006

(16) is a soil; (17) the immediately underlying subsoil taken to a depth of a few inches; (18) is also a subsoil taken from the same holes, but at a depth of three or four feet.

In regard to the land from which (16), (17) and (18) were taken, Mr. H. P. Walker, of Auburndale, Polk County, says:

"Adjacent to the lakes of this community are strips of high hammock lands, much of which has been set to orange and lemon trees, which are more or less effected with die-back." He describes a tract of "high gray hammock" of one fourth mile lake frontage, trees (orange and lemon) of which within fifty yards of the lake have die-back. He is convinced that the trouble arises from "the superabundance or deficiency of some chemical element or elements in the soil which can be overcome by the application of proper fertilizers." This evil is discouraging many growers.

The analysis would seem to indicate deficiency of phosphoric acid, potash and also, perhaps, lime. What sort of growth was on the land before put to oranges? Did this growth indicate poverty of soil? If so, the conclusion is justified that deficiency of plant food is the trouble, in which case a liberal application of complete manure is the remedy.



SECOND STORY

a. a. a. a. Work tables; c. c. c. c. Hoods; s. s. s. s. Sinks.

The laboratory is provided with a complete system of sinks, pipes, etc., etc., for bringing in and carrying away water, which is supplied, under high pressure, from the city water-works. There are numerous hoods for carrying off noxious gases, and thorough ventilation of the work-rooms is still further secured by special flues for that purpose.

In the basement are rooms for chemical supplies, gas machine, water-closet and storage of fuel, etc., etc.

On the first floor is the Director's office communicating with the library. On the left is the office, weighing room and private laboratory of the Professor of Chemistry. Back of these is the students' laboratory. The lecture-room is above—on the second floor. Just back of and convenient to the lecture-room are compartments for the orderly arranging and storing away of the apparatus and specimens used in illustrating lectures. On this floor also are the office and work-room of the Entomologist of the Station.

BULLETIN No. 7

OF THE

EXPERIMENT STATION

OF FLORIDA,

AT THE

STATE AGRICULTURAL COLLEGE,

LAKE CITY, FLORIDA.

OCTOBER, 1889.

REV. JAS. P. DEPASS, DIRECTOR.

JACKSONVILLE, FLA.,
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1889.

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CORN EXPERIMENT.

TABLE.

PLOT 1.	Brand Fertilizer used.	Amt. per acre of Fertilizer.	Distance apart in drill.	Width of rows.	No. bus. per acre.	No. times worked.	Cultivator used.	How Fertilized.
1st Ex —Fodder pulled.....	Fot. Ammonia.	1 ton.	20 inches	4 ft.	20 bu. 10 qts.	8	Planet Junior No. 2	Broadcast
2d " Fodder not pulled	" "	"	" "	"	26 bu. 20 qts.	"	" "	"
3d " Fodder pulled....	Cotton seed meal.	"	" "	"	25 bu.	"	" "	"
4th " Fodder not pulled	" " "	"	" "	"	32½ bu.	"	" "	"
5th " Fodder pulled. ...	No fertilizer.	....	4 ft.	"	19½ bu.	"	" "	....
PLOT 2.								
6th Ex.--Fodder pulled....	Crushed cotton seed.	½ ton.	"	"	19½ bu.	"	Terry Plow	Broadcast
7th " " " ...	" " "	"	"	"	21 bu. 4 qts.	"	" "	In hills
8th " " " ...	Gossypium.	500 lbs.	"	"	27 bu. 20 qts.	"	" "	" "
9th " " "	Blood and bone.	"	"	"	19¼ bu.	"	" "	" "
10th " " "	Rotten bone.	"	"	"	25 bu.	"	" "	" "
11th " " "	....	....	"	"	18 bu.	"	" "	" "

REMARKS.

The experiments in corn have developed some points which are worthy of consideration. I suggest a few, and invite the thoughtful reader to a careful study of the above table.

To insure a good stand, where the seed was planted in the hill, the fertilizer was placed on each side of it, so as not to injure its germ. The two plots were prepared by being broken up with a two horse plow and harrowed with Clark's Cutaway Harrow. On that part of plot 1 where the corn was drilled, the fertilizer was sown broadcast before the soil was broken up and at the last plowing. In the hill corn in plot 1, and also in plot 2, the fertilizer was placed when the land was laid off after the harrowing. In April and May the crop was subjected to a drought. The effect of the drought was not perceptible on the fertilized corn, either in checking the growth of stalk or in firing it, and its color was a dark green. The unfertilized was not fired either, but its growth was slow and its color light.

Quite a number of old experienced farmers saw the crop during its growth, and pronounced it the finest corn they had seen grown in the State, its average height being about, if not quite, twelve feet. Their estimate, however, of the probable yield of the fertilized crop was as far in excess as it was below that of the unfertilized. This last remark is made in order to show that estimates made by even the most experienced, based upon what is thought to be good evidence, is deceiving. The table above shows that the fertilizers used, both as to quality and quantity, did not increase the yield to that extent as to justify the farmer in fertilizing this crop.

The opinion that it will pay to fertilize corn has been stated as a fact, both orally and through the press, until it has become a prevailing opinion. My own experience heretofore has excited doubt in regard to this, and while I do not pretend to say that the experiments of this year, or even of another, will amount to a demonstration, still, it is clear that the excess of corn made thus far does not pay for the fertilizers. Another year these experiments will be repeated and others instituted with different fertilizers and selected seed.

The seed used was that which has been commonly planted in the State for years. No effort was made to select seed. It is more than likely that the seed had something to do with the yield, since there was no evidence that the fertilized corn had a larger number of stalks which had more than one ear to the stalk. The difference was in the size of the ear. It was noticeable that in each case the ear shot out much above the middle of the stock, and but few stalks had but two ears. When the rains began, the fertilized corn was in the silk and much farther advanced toward maturity than the unfertilized, and that part of plot 1 which was drilled began at once to fire.

THE FODDER taken from these plots amounted to 1,317 pounds, and cost, rating hands at 75 cents per day, within a fraction of 85 cents per 100 pounds.

It will be seen by reference to the table that when the fodder was pulled that the loss in corn per acre was very marked. The question, does it pay to pull fodder? in view of the above facts, is a pertinent one. Hay, mowed with a scythe, taken from eight acres amounted to 12,500 pounds. It is safe to say that had a one or two-horse mower been used the amount would have been nearly doubled, if not quite so.

THE CULTIVATORS used were the Terry and Planet Jr. No. 2. They are very superior tools. The Planet Jr. is lighter and easier handled, cultivating the crop level. The Terry, while heavy, and not so easy to handle by the plowman, runs light and throws dirt lightly to the corn, leaving a valley between the rows. It is a better tool than the Planet Jr. No. 2 in flat, wet land, or on level land when the seasons are wet, but on hilly land or land that is level and dry the Planet Jr. is the best implement. Clark's Cutaway Harrow is a most useful tool, and excels in breaking clods. The usefulness of this admirable tool and its general adaptation to farm work will be noticed in future bulletins.

THE LAND selected for these experiments has been cultivated twenty years, was level, and average pine land for this section.

CUCUMBERS.

The 29th of January I planted cucumbers on the following plan:

A plot five by sixty feet, running east and west, was marked off. This was excavated a foot, the top soil, to the depth of about four inches, being thrown on the south and the subsoil on the north side. The sides were walled with plank two feet above the level of the ground and eight inches on the south. The ground was then spaded, and about four inches of green stable manure spread evenly over it, and covered with the top soil. The seeds were planted three by three feet, and, to insure a stand, five were placed in a hill. Strips one by two inches were nailed across as a rest for an awning, which, on cold nights, was stretched over the inclosure. The awning was made of two widths of cheese-cloth, costing four cents a yard. The plants were uninjured when the thermometer was much below the freezing-point.

The vines began to fruit early and prolifically, and bore through the summer. On September 3 I ate good fruit from them. A mistake, I think, was made in allowing the vines to run beyond the inclosure. Another, possibly, was, that after rains the plants were not covered with the awning as a protection against the sun. The estimate yield per acre was near 1,200 bushels of good smooth fruit, and as much more of culls.

During the dry weather these plants were watered occasionally, but not copiously.

For a family, this would seem the plan to raise this healthy and refreshing vegetable. For market it has been tried with varying ing success, but I am not prepared to recommend it, unless the plants could be regularly and properly irrigated.

CONSTITUENTS OF MUCK.

Numerous inquiries in regard to muck have been sent to the Station The following quotations will make plain the nature of these inquiries: "Send me statement of the properties needed to make it produce corn, beans, Irish potatoes, onions and such like crops." "I desire to have the same (samples of muck) analyzed so as to ascertain their value as a fertilizer." "I would like to know just what the muck contains, and to find out its *commercial* value per ton." "By sending me the analysis, and also by giving me the most practical plan for disintegrating it so that it will mix with the soil, you will confer a great favor on the people of this section, as if it proves of value, it will soon be extensively used on our fields and groves." "I have a good young orchard, a good muck bed, but have never used it yet, not knowing its value." "Please let us know what it lacks of being as good as any commercial fertilizer; or what ingredient or chemical will improve it."

It is the object of this bulletin to furnish data by means of which each farmer may construct for himself answers to the foregoing and similar questions. Eighteen or twenty samples of muck from various parts of the State have been analyzed at this Station. The result of these analyses are presented here in tabulated form. The fertilizer which muck resembles most, is barn-yard manure. For purposes of comparison, analyses of the latter, made by various observers in different parts of the world, are placed alongside of those of our muck.

The figures 41, 42, 43, etc., at the head of the columns (see table I) are the numbers by which the specimens are designated at the Station.

41. Sent on by J. H. Ruff, Shell Creek, and called by him salt or tide-water muck. He says: "Put under cabbage, potatoes, corn, cane, tomatoes, etc., the results are surprising—equally good as cow-pen or stable manure. The only preparation we have given it is to let it lie in a heap for a few months, then apply. In some cases it is put right on when wheeled out." This specimen was light-brown in color, not greatly decomposed, rootlets and fibrous ingredients being quite apparent to the eye.

42. William Gibbs, Orange City, Fla.—From a saw-grass pond. No account of its use. Color of muck, dark brown; pretty well rotted, but fibrous ingredients slightly visible; quite wet.

43 and 44. J. S. Corrigan, San Antonio.—Dark brown; pretty well decomposed; dripping with moisture.

45. Hicks & Clark, Ft. Mason.—"Compost Humus." Dark brown, pretty well decomposed; air-dry.

46. Hicks & Clark, Ft. Mason.—"Calcine Humus." Light brown; well rotted; air-dry. Apparently a mixture of humus and marl.

47. P. Tischler, Jacksonville.—(Specimen No. 1), dark brown, pretty well decomposed, though fibrous matter quite visible; moist. 48 (Specimen No. 2), light brown, decomposition not far advanced, grass-stalks, roots, etc., abundantly visible; air-dry.

49. C. Jones, for H. F. Davis, Bowling Green.—Very dark, nearly black; decomposition well advanced; very moist.

50. G. B. Griffin, Windsor, Alachua county.—Light brown; decomposition not far advanced; air-dry. Specimen taken from near the surface of a bed 15 feet deep. Large quantities of it used, but no statement of its effect on crops given.

51. Sent on by W. S. Hart, Hawks Park.—Dry, hard, greyish cake, to be disintegrated only by use of considerable force as with pestle and mortar; scarcely any appearance of vegetable origin; from an island in the Hillsborough River.

52. W. N. Jackson, Lane Park.—Brown; decomposition pretty well advanced; air-dry. Specimen from a "boy head" (or "bay head?"). Has fertilized with it considerably, and "believes it a good thing to use, but not alone."

53. B. M. Burdett, Killarney.—Specimen from a ditch, light brown; air dry. Decomposition not far advanced.

54. W. E. Botts, Eldridge.—Light brown. Decomposition not for advanced, contains much grass and undecomposed vegetable matter; moist.

70. J. C. Phillips, Brooksville, Fla.—Grey; only slightly rotted; air-dry.

The next column (not numbered) contains the average analyses of three specimens, taken, two of them, from rather a hill in open pine woods, the other from what in wet weather is a pond. Specimens very dark, well decomposed; air-dry. Sent on by W. B. Knight, Lake City, Fla.

TABLE I.

	FLORIDA MUCK.—J. J. EARLE, ANALYST.															BARN-YARD MANURE.					
	Tide-Water Muck.	Muck From a Saw-Grass Pond.	Source Not Given.	Hammock Muck.	Compost Humus.	"Calcine Humus."	Source Not Given.	Source Not Given.	Source Not Given.	Source Not Given.	From an Island in a River.	From a "Bay Head."	From a Ditch.	Source Not Given.	Source Not Given.		Fresh.	Half-Rotted.	Rotted.	Mixed.	Sheep Dung.	COTTON-SEED MEAL.
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	70							
Water at 212°	29.13	84.72	83.30	80.88	61.32	47 82	74.59	24 55	64.12	17 10	14 83	63.97	73.84	24 10	14.30	5.28	66 17	79 62	75 42	72.48	73.13	8 31
Organic and Volatile Matter	55 27	12.42	12.26	14 33	23.80	22.09	21.78	66 88	18 48	70 85	16.27	34 18	16.68	73.60	33.40	61 97	28 24	13.82	16 53	13 94	20.28	85.39
Sand and Insoluble Matter	8 36	2 28	3 56	4 11	12.82	13 51	3.22	7 93	16 29	9 97	56 63	1.11	4.73	1.87	44 20	31 48	...	......	......	......	..	.58
Soluble Mineral Matter	7.24	.58	88	.85	2.06	16 58	.41	61	.81	2.08	12 22	.79	4.75	43	8 10	1.25	5 59	6.56	8.05	......	6.59	5.69
Total	100.00	100.00	100 00	120 00	100.00	100.00	100.00	100 00	100.00	100.00	100 00	100 00	100 00	100 00	100 0	99.98	100 00	100.00	100.00	......	100 00	100.00
Org. Matter Contains Ammonia	.81	.55	56	.62	.97	1 01	.72	3 30	.59	3 10	.83	1.40	......	1 10	.....	1 31	.78	.41	......	.46	1.15	5.77
Soluble Mineral Matter Contains:																						
Phosphoric Acid	.22	......	......	......	.05	38	......	.. ..	...	....	.24	......	......	......	67	.....	.32	.20	.41	.31	......	1.87
Potash	.13	......	......	......	.06	.85	......	.....	......	.	.77	......	......	.. ..	.21	.....	67	51	.49	.32	......	1.54
Soda	.75	......	......	......	.12	.13	......	.....	......	....	1.68	......		......	3 55	.....	11		.08	.16	......	.17
Lime	.46	......	....	......	.33	12.10	... ..	......	.....	.. .	.22	......	3 71	......	1 08	.....	1.19	.56	1 78	.59	...	.78
Magnesia	34	....	...	......	.12	.08	.. ..	..	....		.07	......	......	.....	62	.....	15	.24	.12	.62	.....	1.08
Sulphuric Acid	1 25	....	...	.....	.25	.45	......	......	....	....	90	......	.30	......	91	.....	.12	.18	.12	.12	....	.....
Oxides of Iron and Aluminum	8.92	......	......	......	1.36	2.77	.....	......	....	......	9.18	......	.67	......	2.16	.....	.42	.40	.67	.45	.....	.....
VALUE PER TON. Ammonia	$1 62	$1 00	$1 12	$1 24	$1 94	$2 02	$1 44	$3 60	$1 18	$6 20	$1 76	$2 80	.....	$2 20	$	$2 62	$2 34	$1 20	$	$1 88	$3 45	$17 31
Phosphoric Acid	26		......	....	06	44	..	......	......	.....	80	......	..	.....	80	.....	38	48	53	59	......	2 24
Potash	12		......	...	05	76	......	......	......	......	69	...	......	......	20	....	60	45	44	28	.....	1 88
Total	$2 00	......	......	......	$2 05	$3 21	...	....	......	......	$2 75	....	......	.. ..	....	.. ..	$3 32	$2 13	......	$2 16	....	$20 93

WHAT THE ANALYSES TEACH.

In studying the foregoing table (I), especial attention should be directed to the organic or vegetable matter, the ammonia, the phosphoric acid and the potash. It will be noted that the organic matter varies from about 12 pounds to about 74 pounds in every 100 pounds of muck, in the barnyard manure from about 14 to about 30 per hundred. The ammonia in the muck ranges from about one-half to 3 pounds per hundred; in the barnyard manure, from about one-half pound to about 1 pound. Cotton-seed meal contains about 6 pounds of ammonia to the hundred. Cotton-seed meal is a highly ammoniated manure, though not so much so as some guanos, which contain as much as 15 or more pounds of ammonia per hundred. It will be noted that the higher the per cent. of organic matter, the higher is the contents of ammonia. It is the organic matter, mainly, that gives value to muck; where that is large in comparison to the quantity of sand, the muck will be generally found valuable. The phosphoric acid in the muck ranges from a fraction of an ounce to about three-fourths of a pound to the hundred; in the barn-yard manure, from one-fifth of a pound to near one-half pound per hundred; in cotton-seed meal it is about 2 pounds per hundred. The potash ranges in the muck from less than an ounce to about eight-tenths of a pound per hundred; in the manure, from about 5 ounces to seven-tenths of a pound per hundred; in the cotton seed meal it amounts to about 1½ pounds to the hundred.

The authorities agree that the plant food in muck is much less readily available than that in barnyard manure—especially is this true of the nitrogen. In making out an estimate of the commercial value of muck as compared with barnyard manure and cotton-seed meal, ammonia is put at 10 cents a pound in the former and 15 cents in the latter two. The potash and phosphoric acid are estimated at 4½ and 6 cents respectively in all. Applying these figures, it is seen that the muck is rated at from $2 to about $3 per ton; the barnyard manure at about the same, whereas the cotton-seed meal is rated at about $21 a ton. But it is well known that estimates of this kind must be taken with due allowances. The commercial valuation does not always correspond with its crop-producing value.

The total value of only a few samples—those which were completely analyzed—is given. The valuation of the ammonia alone ranges from $1 to over $6.

TABLE II.—AVERAGES.

		Muck. A	Muck. B	Barnyard manure. C	Cotton-seed meal. D	Commercial Fertilizer. E
Moisture at 212°		50 81	33 48	72.11	8 34	6.49
Organic and volatile matter		37 41	29.56			
Sand and insoluble matter		14 81	27.11			
Soluble mineral matter		8.98	9.24		5.69	
Ammonia		1 20	0.93	0.70	5.77	2.56
(Equivalent to nitrogen)		0 99	0.76	0.58	4.77	2.12
Oxides of iron and aluminum			3 88			
Lime			2.84	1.74	0.78	
Magnesia			0.24	0 09	1.08	
Phosphoric acid			0 31	0.82	1 87	12.10
Sulphuric acid			0 83			
Potash			0 26	0.79	1.54	8.36
Soda			1 31		0 17	
Value per ton.	Ammonia	$2 50	$1 86	$2 10	$17 31	$ 7 65
	Phosphoric acid		37	88	2 24	14 52
	Potash		23	71	1 38	3 00
	Total		$2 46	$3 19	$20 93	$25 18

Column A contains the average of the whole sixteen samples of muck; B the average of the five samples which were completely analyzed namely, Nos. 41, 45, 46 51, and 70. Column C contains the average of six analyses of barnyard manure (mixtures of horse, cow, and hog manure), in different stages of decomposition, from 14 days to 8 months old (analyses by Voelcker). D average of five analyses of cotton-seed meal, made at the Massachusetts Experiment Station E, the analysis of a standard commercial fertilizer.

These figures represent, as do those in all the tables, the per cent. of the different ingredients; or, to express it more plainly, the number of pounds of each ingredient contained in a hundred pounds of muck, etc. The ammonia is estimated as worth ten cents a pound in the muck, and fifteen cents in the other fertilizers. The phosphoric acid and potash are estimated in all at six, and four and one-half cents a pound respectively.

Table II is designed to give a general idea of the relative value of the manures there described. It will be noted that muck contains considerably more ammonia than barn-yard manure, considerably less potash, and about the same amount of phosphoric acid. The phosphoric acid was determined in only five samples of our muck. It may be that if a larger number of determinations were made that the average would be brought lower. However that may be, it has not heretofore been found that muck contains generally as much phosphoric acid as barnyard manure. It is generally understood, and our analyses bear out the conclusion except as to phosphoric acid, that muck contains *more* ammonia, but *less* potash and phosphoric acid than barnyard manure.

TABLE III.

WATER-FREE MUCK.

(This table shows what would be the composition of Muck if freed from water).

	41	42	43	44	45	46	47	48	49	50	51	52	53	54	70	
Organic and Volatile Matter................	77.98	81.30	75 81	74.97	61.53	42.33	83.74	88.64	51.93	85.46	19.10	94.75	63.76	96.96	37.80	65.42
Sand and Insoluble Matter....................	11.80	14.99	19.42	21.49	33.14	25.89	12.66	10.51	45.78	12.02	66.55	3.08	18.08	2.46	51.57	33.28
Soluble Mineral Matter..................	10 22	3.71	4.77	3.54	5.33	31.78	3.60	0.75	2.29	2.52	14.35	2.17	18.16	0.54	10.63	1.35
	100.00	100.00	100 00	100.00	100.00	100.00	100.00	99.90	100.00	100.00	100.00	100 00	100.00	99.96	100.00	100.00
Ammonia in Organic Matter................	1.14	3.61	3 06	3.24	2 50	1.93	2.83	4.37	1 65	3.74	1 03	3.88	......	1.44	......	......
SOLUBLE MINERAL MATTER CONTAINS:	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Oxides of Iron and Aluminum...............	5.53	......	......	......	3 51	5.30	......	......	......	......	10.77	......	......	......	2.52	......
Lime	0.65	......	......	......	0.85	23.18	......	......	......	......	0.25	......	......	......	1.26	......
Magnesia	0 47	......	......	......	0.31	0.15	......	......	......	......	0.08	......	......	......	0.72	......
Phosphoric Acid..................................	0.31	......	......	......	0.13	0.73	......	......	......	......	0.28	......	......	......	0.78	......
Sulphuric Acid....................................	1.76	......	......	......	0.63	0 86	......	......	......	......	1.05	......	......	......	1.06	......
Potash...	0.18	......	......	......	0.15	1.62	......	......	......	......	0.90	......	......	......	0 24	......
Soda..	1.06	......	......	......	0.31	0.24	......	......	......	......	1.97	......	......	......	4.14	....

Table III presents the same analyses as those in Table I, but here the water has been eliminated and the percentages calculated on the basis of water free muck. The farmer never has to deal with water-free muck. Its power of absorbing and retaining moisture is, indeed, one of its most valuable properties Still an inspection of this table will emphasize what a vast saving of labor it would be if muck could be freed economically of even half of its moisture, before it is hauled from the muck bed to the compost heap. By properly throwing up the muck onto rail scaffolding (see Dr. Neal's directions under the head of composting), much of the moisture can be gotten rid of. But there is an ingredient which, unlike water, is of no value and cannot be gotten rid of—sand. It will be instructive to compare two mucks, one having a large per cent. of sand and one having a large per cent. of moisture. Let the comparison be made between them in the wet and the dry state. Take for this comparison samples 42 and 51:

	WET.		DRY.	
	42	51	42	51
Water	84.72	14.83	none	none
Organic Matter	12.42	16.27	81.30	19.10
Sand	2.28	56.68	14.99	66.55
Ammonia.	0.55	0.88	3.61	1.03

The valuable ingredients in 51 in the wet state (organic matter 16.27, ammonia 0.88) are much greater than in 42 (organic matter 12.42, ammonia 0.55). In the dry state, this relation is changed, 42 containing more than three times as much ammonia and four times as much organic matter as 51. While in the wet state 51 contains more organic matter than 42, the *relative* amount of organic matter to the amount of sand in each is quite different; 42 has about six times more organic matter than it has of sand, whereas in 51 the contents of sand is more than three times greater than that of organic matter. In judging of the value of muck, not merely the amount of organic matter, but the amount as compared with the amount of sand must be taken into account. The color of muck is not a criterion of its value, except, perhaps, in so far as it may indicate a more or less advanced stage of decomposition; the darker mucks are generally farther advanced in decomposition than the lighter colored.

These analyses bring out very clearly that muck is exceedingly variable in quality. This is equally true of barnyard manure, which varies, as is well known, with the kind of animal producing it, the age of the animal, the kind of food he eats, and the care with which the dung is preserved.

Does it pay to apply muck as a fertilizer? That is a question to be answered by the circumstances of the case; the points to be considered in each case are, first of all, the quality of the muck, the distance it must be hauled, and the labor necessary to put it into condition. In the case of barnyard manures, some authorities say that seven to ten tons per acre is a light, twelve to eighteen tons an ample, twenty or more tons a heavy, and thirty tons a very heavy application. If properly weathered and mellowed and applied in similarly large quantities, I cannot see why any of the mucks analyzed here, except possibly 51 and 70, which contain a large per cent. of sand, might not produce effects similar to barnyard manure. The question, however, is one to be answered for each muck bed, and by each planter for himself. And the only way to answer it is by actual experiment in the field. Let tenth-acre plots, similar in soil, previous fertilization and cultivation, be *measured* off. Apply *measured* quantities of muck to some of them, barnyard manure to others, no manure whatever to others. Plant all to the *same* crop; for purposes of comparison there is, perhaps, nothing better or more convenient than maize or Indian corn. Subject all the plots to similar cultivation. Don't judge the yield by *appearances* merely, but *measure* or *weigh* the crop of each plot. Keep a written record of all the operations and results of the experiment. This will take time and trouble, but I know of no other way of arriving at a reliable knowledge of the question involved. The crop produced will, perhaps, more than pay for the labor expended, and the knowledge gained will serve as a guide for the more extensive operations of the farm.

Dr. J. C. Neal, who has had a large experience with Florida muck, has kindly prepared an article on the composting of muck, which see in this bulletin.

The following Table IV of analyses of different kinds of barnyard manure were made by various analysts and are copied from Storer. They will be of help to thoughtful planters.

J. M. PICKELL.

TABLE IV.

BARNYARD MANURE.

(These analyses with explanatory notes are taken from Storer's Agriculture).

	Cow Manure.						Horse Manure.					Sheep.		Swine
	I	II	III	IV	V	VI	IX	X	XI	XII	XIII	XV	XVI	XVII
Water.	85.30	77.71	74.02	72.87	75.00	77.50	75.76	69.30	67.28	72.13	71.30	69.30	64.60	72.40
Dry Matter	14.70	22.30	25.98	27.13	25.00	22.50	24.24	24.82	32.72	27.87	28.70	30.70	35.40	27.60
Ash ingredients	2 04	4.71	3.94	6.70	6.22	2.20	5.07	5.05	6.49	3.37	3.30	6.69	3.60	2.60
Potash	0.36	0.46	0.56	1.69	0.39	0.40	0.51	0.63	0.22	0.59	0.53	0.77	0.67	0.60
Lime	0.29	0.37	0.58	0.41	0.21	0.31	0.30	0.74	0 17	0.41	0.21	0.60	0.33	0.08
Magnesia.	0.19	0.11	0.13		0.18	0.11	0.19	0.29	0.20	0.17	0.14	0.06	0.18	0.09
Phosphoric Acid	0.16	0.13	0.07	0.20	0.14	0.16	0.41	0.67	0.35	0.12	0.28	0.21	0.23	0.19
Nitrogen	0.38	0.54	0.41	0.79	0.46	0.34	0.58	0.69	0 47	0.67	0.58	0.61	0.83	0.45

COW MANURE.

"I. Fresh cow manure from animals fed on as much hay as they would eat, with daily additions of four quarts of wheat bran and four quarts of mangolds. A cubic foot of this manure weighed 63 lbs. (S. W. Johnson.)

"II. and III. Taken in February from the centre of dung-heaps at two different cow stables in Germany. (Schmid.)

"IV. Four-weeks-old manure from a cow stable where the fodder consisted of a mixture of 100 lbs. of green cut clover and 5 lbs. of rye straw. (R. Hoffman.)

"V. Cow manure. (Bretschneider.)

"VI. Average composition of fresh cow manure with litter. (Wolff.)"

HORSE MANURE.

"IX. Fresh horse manure from stables in New York city. The material contained no long straw, and weighed 35 lbs. to the cubic foot, *i. e.*, 4,535 lbs. to the cord. (S. W. Johnson, Conn. Agric. Rep., 1873, p. 348.)

"X. Sample from a cargo of horse manure from New York city. (S. W. Johnson, Rep. Conn. Agric. Ex. Station, 1880, p. 43.)

"XI. Fresh horse dung collected from an animal fed daily on 14 lbs. of timothy hay and four quarts of oats, mixed with cracked corn. The dung was collected in dry winter weather, a few hours after it had been dropped. A sample of fresh dung was found to contain 73.86 per cent. of water. (R. F. Kedzie, in laboratory of the the Bussey Institution.)

"XII. Horse manure. (Bretschneider.)

"XIII. Average composition of fresh horse manure with litter. (Wolff)"

SHEEP AND SWINE MANURE.

"XV. Sheep manure. (Bretschneider.)

"XVI. Average composition of fresh sheep manure with litter. (Wolff.)

"XVII. Average composition of fresh hog manure with litter. (Wolff.)".

GENERAL CHARACTERISTIC OF MUCK.

The great differences in the composition of some of the above samples of muck, result from their mode of formation, being either formed by the gradual decay of the fallen leaves and branches of deciduous trees, or by the accumulation of grasses and undergrowth in marshy places. In the latter case the muck will have more vegetable matter and less sand, and will consequently be richer, as its value depends largely upon the amount of vegetable matter contained.

Peat or muck should never be applied to the soil immediately after being dug, for in many cases harmful results will follow. "Most peats possess a certain antiseptic or germicide quality (acidity) when freshly dug, whichwould be likely to hinder nitrification as well as the other forms offer mentation and decay." Most of our peats which are formed in marshy places, often contain iron sulphide (FeS_2) which, on being exposed to the air, is rapidly oxidized to copperas or soluble sulphate of iron ($FeSo_4$). This salt of iron is very poisonous to plants, and for this reason muck should always be well weathered or seasoned before being applied to the soil. In many cases the above harmful results would not follow by applying the freshly dug peat, yet it would do the land little or no good for some time to come, and it is a well-known fact that seasoned muck is far superior to the freshly dug.

Muck is of value to the soil both on account of its power of absorbing and retaining moisture and in improving the general tilth of the soil, which makes it especially adapted to our light sandy soils, and on account of the elements of plant food which it contains.

With the exception of the small amount of mineral matter, the nitrogen is the only element of plant food in muck. This exists, however, in such an inert form and in such small quantities (about 17 pounds in a ton) that if muck be applied directly to the soil, the decomposition would be so slow that its value would be hardly felt. In order for the nitrogen to be rendered immediately available, the muck must be first composted. Too much stress cannot be laid upon the composting of muck. Professor Storer says that "if some kinds of peat be mixed with fresh stable manure in the proportion of two or three loads of muck to one of ftable manure, and the mixture is allowed to ferment, there will be sormed a compound as efficient, load for load, for many fertilizing purposes as pure stable manure." J. J. EARLE.

MUCK COMPOSTING.

It takes but little study of the foregoing analyses, to note some gratifying and surprising facts. They show the average peats of Florida to be superior to those found in northern States, and that with but little expense or trouble they can be composted to be but slightly inferior to a good grade of stable manure.

The reasons for these immense areas of merely pure vegetable matter in all parts of Florida are obvious. The heavy rains sweep the constantly decaying vegetation into shallow depressions, edges of ponds and sinks, almost free from sand or clay, there to form bay-heads and muck beds only needing careful development to become of immense value to our farming interests. There are a few drawbacks and deficiencies, easily and cheaply remedied. Mucks like No. 41, with 649 pounds sand and water, and but 261 pounds available soluble substances in a ton, or No. 43, with 1,731 pounds sand and water to the ton, are hardly worth the digging. Water is detrimental if the muck is to be hauled any great distance, and most of the analyses emphasize the utility of drying as far as possible the peat before composting.

Deducting the sand, water, ammonia and soluble minerals from, say No. 41, leaves 1,090 pounds in a ton, of organic material, dark colored and of little value as a manure—applied to land it is a help, however, lightening the soil, thus enabling tender rootlets to penetrate every direction, and its deep color aids in retaining heat, but by far its best value is the great power it has of absorbing moisture and ammonia when composted with rapidly decaying organic materials like cotton seed, manure, ground fish, etc. A pile of air-dry muck should be kept for use in absorbing the slops, urine, liquid fæcal matter and refuse of the house and barn. In this way there is a saving of dangerous material to health of man and beast, and its conversion into a highly valuable fertilizer, utilizing a very common and tremendous waste.

COMPOST-MAKING.

In Florida, the months of February, May and October are usually very drouthy, and this fact can be utilized in digging the peat, which should be piled on rail or board platforms to become air-dry. Specimens like Nos. 42, 44, 47, 49, 52, and 53, contain from 1,200 to 1,700 pounds water in the ton, which, if air-dry, would average only from 300 to 600 pounds water in the ton The saving in hauling is very obvious.

It is best to make a pen of rails or boards, conveniently, with strong posts at the corners, and from eight to ten feet square. Beginning with at least six inches of finely pulverized and dry muck (and the pulverizing is a point upon which too much stress cannot be laid), then three inches of the cotton seed, or manure; thoroughly wetting it, if possible with a solution of kainit, or ashes, then six inches more muck, and so on till the heap is complete, then cover with dry muck—let this stand a month, note if it dries out, and supply water freely to promote decomposition and prevent waste of ammonia.

Cotton-seed meal, one inch in depth, can be used instead of the whole seed, and if chemicals are available, as kainit, ashes, krugit, muriate and sulphate potash, acid phosphate and floats, sprinkle them over the layers of muck, and use water freely to assist solution.

At the end of a month, I have found it advisable to turn over the heap, remoisten and repile. This should be done monthly, until there is evidently complete decomposition, and if chemicals are used, that none are perceptible in the mass.

When one has the time to allow it, a preparatory compost with freshly slacked lime is an excellent thing. An acid muck, or one containing an excess of iron, as Nos. 41 and 51, is greatly benefitted. Six inches muck, then one inch lime, then muck, and so on, allowed to remain a few months for the compost to decompose, the acids to be neutralized, and the iron to be rendered insoluble, this composted with other materials is especially valuable.

I have a high opinion of the value of unleached ashes, and in combination with muck I have had fine results, both with trees and vegetables.

Containing, as good ashes do, all the constituents of plant food, they seem to render mucks more speedily available than most chemicals, and in use, cause an extremely solid growth of plants and trees.

Muck will require the addition of 11 lbs. potash to each ton, to render it equivalent to well-rotted manure, granting that the phosphoric acid and ammonia were as available as in the manure. This is, however, not the fact, and in practice it is preferable to use an excess of chemicals far above the analyses.

I give a few formulas that I hope will meet almost every case, and answer the many queries that are constantly sent the Experiment Station :

(1) 1 ton stable manure,
2 tons muck,
200 lbs. kainit,
100 lbs. acid phosphate. This will analyze 16 lbs. potash, 9 lbs. phosphoric acid, and 17 lbs. ammonia to the ton. Almost exactly as stable manure.

(2) 7,500 lbs. muck,
400 lbs. kainit,
100 lbs. acid phosphate. Analyzes 17 lbs. potash, 13 lbs. phosphoric acid, 17 lbs. ammonia in a ton. Very good for slow growth crops or bearing fruit trees.

(3) 2 tons long staple cotton seed.
2 tons muck,
50 lbs. muriate or sulphate potash. 19 lbs. potash, 18 lbs. phosphoric acid, 35 lbs. ammonia in a ton. Valuable for peach or orange trees.

(4) 2 tons cotton-seed meal,
4 tons muck,
½ ton kainit,
½ ton acid phosphate. This has 23 lbs. potash, 29 lbs. phosphoric acid, 43 lbs. ammonia per ton. Very stimulating for early gardens.

(5) 5,800 lbs. muck,
200 lbs. kainit,
2,000 lbs. cotton-seed meal. In a ton of this compost are 24 lbs. potash, 13 lbs. phosphoric acid, and 44 lbs. ammonia. Equivalent to double the amount of stable manure.

(6) 1 ton ashes,
4 ton muck,
1 ton cotton-seed meal. Gives 30 lbs. potash, 15 lbs. phosphoric acid, and 31 lbs. ammonia per ton. Fine for peach and orange trees.

(7) 1,000 lbs. cotton seed,
2,000 lbs muck,
1,000 lbs. manure,
500 lbs. kainit,
500 lbs. acid phosphate. This is about the same as the Furman or Georgia Formula, giving 31 lbs. potash, 29 lbs. phosphoric acid, and 16 lbs. ammonia to the ton. Very good for cotton, corn, and other long-growing crops.

(8) 1 ton ashes.
2 ton muck. Gives 48 lbs. potash, 15 lbs. phosphoric acid, and 12 lbs. ammonia to the ton, and is a good fertilizer.

(9) 1 ton each cotton-seed meal, kainit, muck, and acid phosphate, well composted, would give a quickly acting fertilizer for use in the hill, or late in the season; having 72 lbs. potash, 61 lbs. phosphoric acid, and 34 lbs. ammonia to the ton.

(10) 1 ton cotton seed,
1 ton kainit,
1 ton acid phosphate,
4 tons stable manure,
4 tons muck. Makes an exceedingly rich compost, with 91 lbs. potash, 70 lbs. phosphoric acid, and 47 lbs. ammonia to the ton. This is very stimulating and lasting, invaluable for tobacco or early vegetables.

(11) 1 ton stable manure,
3 tons muck. This, used in large quantities, often gives fine effects, but the muck should be well dried before composting, and often turned over. It will analyze 7 lbs. potash, 6 lbs. phosphoric acid, and 14 lbs. ammonia to the ton, and should be applied in from 6 to 8 tons to the acre.

In all these cases, the fineness of the compost increases its value greatly.

A ton to the acre, and in the hill, will give about a pound to each plant, though less can be used of formula 4 and 10, and more for formulas 5 and 8.

Mucks vary greatly in weight, as No. 50, 14 lbs. to the cubic foot, and No. 49, 66 lbs. to the cubic foot, but an ordinary compost will average 65 lbs. to the cubic foot, which will be a guide to the weights of compost heaps.

J. C. NEAL.

BULLETIN No. 8

AND

ANNUAL REPORT

OF THE

EXPERIMENT STATION

OF FLORIDA,

AT THE

STATE AGRICULTURAL COLLEGE,

LAKE CITY, FLORIDA.

JANUARY, 1890.

REV. JAS. P DEPASS, DIRECTOR.

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1890.

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INTRODUCTION.

I give in this Bulletin Experiments No. 1 and 2, with black-seed or long staple cotton. While they are not as satisfactory as they ought to have been in consequence of late planting, unskilled labor, protracted drought in spring, and excessive rains in summer; still they are of sufficient importance to warrant me in giving them to the public. Experiments in rice, sugar cane, grasses and cereals, were not satisfactory, but I shall give further attention to them and report in future Bulletins.

Large experiments are being made with deciduous and other fruits, but as yet no developments worthy of public mention have occurred.

JAS. P. DEPASS, Director.

COTTON EXPERIMENT WITH LONG OR BLACK-SEED COTTON.

FIRST EXPERIMENT.

The land selected was high, rolling and sandy, having been cleared quite a number of years. Two acres were planted, one with very fine and prolific seed obtained from H. F. Dutton & Co., of Gainesville, Fla. The other was the Alford cotton which had the reputation of being prolific and of a good quality. On each acre was placed 250 pounds of black cotton-seed meal, and 250 pounds of Pot Ammoniac, manufactured by The Madison Cotton Ginning Co. The cost per acre was $5.82½ The land was prepared by bedding. The fertilizer was placed in the row when the land was laid off, then covered and then opened by a four-inch bull-tongue, then the seed planted and covered with a board. The patch was planted on the 9th of April, in the beginning of a drought which lasted over two months. The stand was, in consequence, a very poor one. Several replantings with the same quality of seed failed to secure a good stand; and failing in seed, resort was had to any that could be had, which was the sweepings of a gin-house. With the last replant only one-eighth of an acre had a good stand, the balance being about one-half. When the drought was broken by a rain, about the first of June, the cotton patch presented a very unpromising appearance. The plants ranged in size all the way from two inches to eight in height, but grew off rapidly, fruiting heavily from the ground up.

On the eighth of an acre, where the stand was good, there were picked 130 pounds of seed cotton which, on the gins of Capt. A. B. Hart, yielded forty pounds of lint. On the two acres were gathered 787 pounds, an average of 393½ pounds per acre. That part which was not fertilized had a poor stand on it and the cotton from it is estimated as if the whole acre had been fertilized. A new Superintendent coming on the farm between the planting and gathering of the crop, was not aware of the unfertilized plot until after the first picking. But one-third of each acre was not fertilized. The estimate of the unfertilized rows was thought to be about 175 pounds to the acre. But, making it 200 pounds, it will be seen that the expenditure of $5.82½ an acre, even when the year was as unfavorable as this one, was not an unprofitable investment of fertilizer.

If the eighth of an acre which yielded 130 pounds of seed cotton, and which had a fairly good stand, which ordinarily can be had any year, with careful fertilizing, planting and working, had obtained on the entire plot, the yield per acre would have been 1,040 pounds seed cotton, or 320 pounds of lint.

There is no doubt but that the yield of lint is largely dependent upon the character of the fertilizer used. A good stand of cotton is also dependent largely upon the first working. If the running round cotton and chopping out with hoe was substituted by simply cutting out with a hoe and thinning by hand, at once supporting the plants left by drawing a little dirt to them, the result would no doubt be better. A great deal of cotton, when young and tender, and cotton is one of the tenderest of plants, is killed by careless hoeing. The desire to get through quickly and save expense and time proves generally a greater cost than by being patient and careful. But the cotton experiment was not a fair one this year for the following reasons:

1. The land was prepared, fertilized and planted at the same time. The fertilizer should be put in at least two weeks before the seed, to insure a stand from the first planting.

2. The seed were planted nearly a month later than they ought to have been to insure the best results.

3. The seed were planted after the ground was too dry to sprout them and did not have rain on them for nearly two months.

SECOND EXPERIMENT.

The next experiment was on three-quarters of an acre of old land, fertilized at the rate of 500 pounds of cotton-seed meal to the acre, costing $3.80¼. The seed was what I could collect by sweeping a gin-house. The land was thin, sandy and hilly. The patch was planted June the 4th, being prepared as in experiment No. 1. The seed sprouted quickly and grew off rapidly, but the stand was injured with the hoe and the plow in the first working, as in experiment No. 1, giving about two-thirds of what is usually called a good stand. The yield was 339 pounds of seed cotton, or 423¾ pounds per acre.

REMARKS.

The question of cotton raising is becoming a serious one in the long cotton belt. The average per acre is being annually reduced by various causes. One fruitful cause is from the rust, another from improper cultivation, and another from the worm. The last enemy science has taught how to combat successfully. The other two remain to be solved by proper fertilization and cultivation.

Old and successful planters realize that neither fresh nor old land yield fruit as freely as formally. They are confronted with the rust, the shedding of bolls and the early dying of the plant, even when the exact methods of cultivation are practiced as when their lands yielded more abundantly. The question is worthy of consideration as to whether both the soil and climate have and are undergoing changes which materially affect the growing and fruiting of this staple product. If this be true so far as the soil is concerned, the remedy through careful experimentation may be found. If the injury sustained arises in part from cultivation not adapted to climatic conditions this may be remedied. It will be seen by the above experiments that while this year the problem is not solved, still, with all the disadvantages of weather and unskilled labor, the indications point to the fact that fertilization and proper work are the chief remedies to what may be, and what is largely believed to be by intelligent farmers, that there has been a change both in soil and atmospheric conditions within twenty-five years affecting the profitable cultivation of this crop. It will be in part the work of the future of the Experiment Station to plant with these facts in view.

The profitable planting of cotton in June, on old land when fertilizers were used, has been long known and frequently resorted to in the past when early planting failed. The practice has fallen into desuetude on account of the ravages of the worm, which generally makes its appearance from July to September in detructive quantities, if it appears at all. Now that it is known that cheap insecticides will readily destroy this pest, late planting should not be neglected, at least to the extent of small areas. The early oat and vegetable patch could be thus utilized, while at any rate late replanting, when the stand is bad, is worth the time and the labor.

WEEDS OF FLORIDA.

Of the 1,900 species of plants that are known to reside within the limits of Florida, either indigenous or living without especial care, less than 300 are ever classed as "weeds," and not quite 50 rated as troublesome by our planters.

Many of these will gradually extend over abandoned fields when very slight cultivation would have kept them in subjection; but others seem to thrive despite the most strenuous efforts for their destruction. The usual classifications, standards and methods of comparison proposed by Northern botanists are not well suited to our Floridian weeds. Very few garden seeds are grown in Florida, and no seeds of field crops, as the clovers, grasses, etc., hence the standards based on weed seeds as adulterants are of little value.

It is not easy to make comparisons with the weeds that are common in the North, as most of them are only occasional visitors that, from some deficiency in the soil or the peculiar climate, seem unwilling to become permanent residents, or they flourish for awhile, then rapidly become sterile and disappear.

The Datura (Jimson) is dwarfed the first year, and rarely sees the third; the Chenopodium album (Lamb's quarter) dies out the second year; Dandelions are but mere shadows of the golden beauties that dot the meadows of the North, while, as far as I know, the Mallows, Burdocks and Hound's tongues have not acquired a permanent foothold anywhere in the State.

It has been a difficult matter to obtain data from the widely separated sections of Florida, as from pressure of business, lack of interest or scant botanical knowledge, but few replies were received from correspondents. The list, therefore, is but a temporary one, with, no doubt, many deficiencies to be supplied in the future.

The asterisk * indicates plants common to all sections of the State; the semi-tropical portion, below 28°, has a special list.

I have arranged the names as nearly as possible in the relative order in which they are found in the central and eastern sections of Florida. The grasses are excepted, as they will be made an especial study in the future.

As a rule I shall refer to these plants by their Latin names, but the English equivalents are given in the list below, as far as known.

OCCASIONAL WEEDS.

1. Portulaca oleracea, L. Pursley.*
2. Sisymbrium canescens, Nutt. Peppergrass.
3. Capsella bursa-pastoris, Mœnch. Shepherd's purse.
4. Glottidium Floridanum, D C. Bladderbean.*
5. Pterocaulon pycnostachyum, Ell. Black root.*
6. Vernonia angustifolia, Mx. Iron weed.*
7. Opuntia vulgaris, L. Prickly pear.
8. Helianthus strumosus, L. Wild Sunflower.
9. Datura stramonium, L. Jimson weed.*
10. Physalis angulata, L. Ground cherry.*
11. Erechthites hieracifolia, Raf. Fireweed.*
12. Pyrrhopappus Carolinianus, D C. Florida Dandelion.
13. Sonchus asper, Vill. Milk thistle.
14. Cirsium horridulum, Mx. Bird's nest thistle.*
15. Heliophytum Indicum, D C. False Heliotrope.
16. Quamoclit vulgaris. Chois. Cypress vine.*
17. Solanum nigrum, L Nightshade.*
18. Amarantus albus, L. Pig weed ?*
19. " chlorostachys, Willd.*
20. " hybridus, L.*
21. Chenopodium album, L. Lamb's quarter.
22. Heteropogon acuminatus, Trin. Broom grass.
23. Taraxacum dens-leonis, D sf. Dandelion.
24. Lactuca elongata, Muhl. Wild lettuce.
25. Asimina parviflora, Dunal. Papaw.*
26. " grandiflora, " " *
27. " pygmæa, " "
28. Crotalaria ovalis, Pursh. Rattlebox.*
29. Erigeron Canadensis, L. Fleabane.
30. Helianthus Floridanus, Gray. Sunflower.
31. Stillingia sylvatica, L. Queen's delight.*
32. Paspalum digitaria, Poir. Crab grass.

AGGRESSIVE WEEDS.

1. Cyperus rotundus, L. Nut grass.*
2. Acanthospermum xanthioides, D C. Paraguay bur.
3. Urena lobata, L. Spanish bur.
4. Daucus pusillus, Mx. Wild Carrot.
5. Amarantus spinosus, L. Careless weed.*
6. Sida stipulata, Cav. Tea weed.*
7. Maruta Cotula, D. C. Dogfennel.
8. Abutilon Avicennæ, Gaertn. Butterprints.
9. Argemone Mexicana, L. Mexican Poppy.
10. Isopappus divaricatus, T. & G.
11. Aplopappus rubiginosus, T. & G.
12. Sonchus oleraceus, L. Milk weed.*

13. Bidens bipinnata, L. Spanish needles.*
14. Xanthium strumarium, L. Cocklebur.*
15. Verbesina enceliodes, Benth. Dogweed.
16. Ipomea tamnifolia, L. Bindweed.
17. Leonotis nepetæfolia, R. Br. Prickly mint.
18. Polygonum Persicaria, L. Knotweed.*
19. " aviculare, L. "
20. Urtica urens, L. Nettle.
21. Lespedeza striata, H. and A. Japan clover.
22. Panicum Curtisii, Chapm. Maiden cane.*
23. Richardsonia scabra. Ipecac weed.

COMMON WEEDS.

1. Cenchrus echinatus, L. Cockspur.*
2. " tribuloides, L. Sandspur.*
3. Ambrosia artemisæfolia, L. Ragweed.*
4. Diodia teres, Walt. Compass weed.*
5. Gnaphalium polycephalum, Mx. Life everlasting.*
6. Rumex Engelmanni, Curtiss. Red weed, Sorrel.
7. Œnothera biennis, L. Evening Primrose
8. " sinuata, L.*
9. Linaria Canadensis, Spreng. Toad Flax.*
10. Chenopodium Anthelminticum, L. Wormseed, Jerusalem Oak.*
11. Cassia occidentalis, L. Coffee weed.
12. " obtusifolia, L.*
13. " Marilandica, L. " " *
14. " Chamæchrista, L. Partridge Pea.*
15. Frœlichia Floridana, Moq. Cotton head.*
16. Mollugo verticillata, L. Carpet weed.*
17. Helenium tenuifolium, Nutt. Fennel.*
18. Eupatarium fœniculaceum, Willd. Fennel.*
19. " coronopifolium, " " *
20. Sesuvium pentandrum, L. Sand Pursley.*
21. Lepidium Virginicum, L. Pepper grass.*
22. Specularia perfoliata, D C.
23. Oxalis stricta, L. Sorrel, Shamrock.
24. Monarda punctata, L. Horsemint.*
25. Passiflora incarnata, L. May pop, Passion flower.*
26. Sida spinosa, L. Tea weed.
27. " rhombifolia, L. Tea weed.
28. Rhus toxicodendron, L. Poison Ivy.*
29. Ambrosia trifida, L. Ragweed.
30. Trifolium reflexum, L. Buffalo Clover.
31. Gerardia divaricata, Chapm.
32. Mulgedium acuminatum, D C. Milk weed.
33. Stachys Floridana, Shuttl. Hedge nettle.
34. Lamium amplexicaule, L. Dead nettle.
35. Callicarpa Americana, L. French Mulberry.*
36. Solanum Carolinense, L. Horse nettle.*

37. Physalis viscosa, L. Ground Cherry.
38. Phytolacca decandra, L. Poke, Garget weed.*
39. Euphorbia hypericifolia, L. Spurge.*
40. “ maculata, L. “
41. Acalypha Virginica, L. Three-seeded Mercury.
42. Croton argyranthemum, Mx. Indian Cure-all.
43. Crotonopsis linearis, Mx. Indian Flax.*
44. Alternantha flavescens, Moq.
45. “ Achyrantha, R. Br.
46. Rumex crispus, L. Dock.
47. “ Acetosella, L. Dock.
48 Polygonum Convolvulus, L. Bind weed.
49. Yucca filamentosa, L. Bear grass.
50. Borreria micrantha, T. & G.
51. Rubus villosus, Ait. Blackberry, Briarberry.*
52. “ cuneifolius, Pursh. “
53. “ trivialis, Mx. Dewberry.*
54. Schrankia uncinata, Willd. Sensitive Briar.
55. Mimosa strigillosa, T. & G. Tassel vine, Sensitive plant.
56. Phaseolus perennis, Walt. Wild Bean.
57. Desmodium molle, D C. Florida Clover, Beggar louse.*
58. Indigofera tinctoria, L. & I., Anil L. Indigo.
59. Ceanothus microphyllus, Mx. Jersey tea.
60. Ampelopsis quinquefolia, Mx. Virginia Creeper.
61. Hypericum mutilum, L. St. John's wort.
62. “ Sarothra, Mx. “ “
63. Cyperus compressus, L. Goose grass.
64. “ Baldwinii, Torr. “ “
65. “ divergens, Kunth. “ “
66. Kyllingia sesquiflora, Torr. Sweet Sedge.
67. Fimbristylis, laxa, Vahl.
68. Trichelostylis autumnalis, Chapm.
69. Scleria oligantha, Mx. Nut rush.
70. Carex laxiflora, Lam. Sedge.
71. Alopecurus geniculatus, L. Foxtail.
72. Sporobolus junceus, Kunth. Wire grass.*
73. “ Floridanus, Chapm. “ “
74. “ Indicus, Brown. “ “. Dropseed grass.
75. Aristida lanata, Poir. “ “
76. “ purpurascens, Poir. “ “ Poverty grass.
77. “ gracilis, Ell. “ “
78. “ virgata, Trin. “ “
79. “ stricta, Mx. “ “
80. “ dichotoma, Mx. “ “
81. Eleusine Ægypticum, Willd. Crowfoot.*
82. “ Indica, Gaertn. Bull grass.*
83. Leptochloa mucronata, Kunth.
84. Eragrostis megastachya, Link.
85. “ ciliaris, Link. Chicken grass.
86. “ Purshii, Schrad.

87. Eragrostis capillaris, Nees. Witch grass.
88. “ pectinacea, Gray. “ “ *
89. “ Brownei, Kunth. Cock's foot grass.*
90. Paspalum Walteri, Schult.
91. “ distichum, L. Wet Bermuda.*
92. “ læve, Mx.
93. “ undulatum, Poir.
94. “ ciliatifolium, Mx. Prairie grass.*
95. “ obtusifolium, Radd. “ “
96. Panicum sanguinale, L. Crab grass.*
97. “ filiforme, L. “ “ *
98. “ hians, Ell.
99. “ anceps, L.
100. “ capillare, L.
101. “ scoparium, L.
102. “ dichotomum, L.
103. “ serotinum, Mx. Blanket grass.*
104. “ commutatum, Schult.
105. Setaria glauca, Beauv. Foxtail, Bottle grass.*
106. Andropogon scoparius, Mx. Broom grass, Broom sedge.*
107. Heteropogon melanocarpus, Trin. Beard grass.
108. Cynodon Dactylon, Pers. Bermuda grass.*
109. Paspalum platycaule, Chapm. Louisiana grass.*
110. Pteris aquilina, L. Brake.*

SEMI-TROPICAL LIST.

AGGRESSIVE OR TROUBLESOME WEEDS.

1. Triumfetta semitriloba, L.
2. Desmodium Floridanum, Chapm.
3. Galactia pilosa, Ell.
4. “ Elliottii, Nutt.
5. Solidago tenuifolia, Pursh. Goldenrod.
6. Bidens leucantha, Wild.
7. Ipomæa Bona nox, L. Moon flower.
8. Canna flaccida, Rosc. Indian Shot.
9. Commelyna communis, L. Spiderwort.

COMMON WEEDS.

1. Nasturtium tanacetifolium, Hook & A.
2. Portulaca pilosa, L. Hairy Pursley.
3. Crotalaria Purshii, D C.
4. Chapmania Floridana, T. & G.
5. Gaura angustifolia, Mx.
6. Ludwigia virgata, Mx.
7. Melothria pendula, L.
8. Hydrocotyle umbellata, L. Penny-wort.
9. Oldenlandia glomerata, Mx. Creeping Greenhead.
10. Melanthera hastata, Mx.

11. Helianthus littoralis, Chapm.
12. Gnaphalium purpureum, L. Cud weed.
13. Cnicus lanceolatus, Hoffm.
14. Lactuca Canadensis, L. Wild Lettuce.
15. " integrifolia, Bigel. Trumpet milk-weed.
16. " graminifolia, Mx.
17. Utricularia subulata, L. Bladder Leaf.
18. Scoparia dulcis, L.
19. Lippia lanceolata, Mx. Fog fruit.
20. Hyptis radiata, Willd.
21. Solanum gracile, Link.
22. Physalis pubescens, L. Ground Cherry.
23. Datura tatula, L. Jimson weed.
24. Acnida australis, Gray. Water Hemp.
25. Polypremum procumbens, L.
26. Iresene celosioides, Ell.
27. Euphorbia Helioscopio, L. Spurge.
28. Jatropha urens, var. stimulosa, Mull. Spurge nettle.
29. Tradescantia rosea, Vent.
30. Cyperus microdontus, Low. Sedge.
31. " strigosus, L.
32. " Baldwinii. Torr.
33. " cylindricus, Britt.
34. Eleocharis capitata, R. Br.
35. Fimbrystylis autumnalis, R. & S.
36. Scirpus stenophyllus, Ell. Bulrush.
37. Scleria laxa, Torr. Nut sedge.
38. Gymnopogon racemosus, Beauv.
39. Chloris petræa, Ell.
40. Paspalum digitaria, Poir. Crab grass.
41. " racemulosum, Nutt.
42. " purpurascens, Ell.
43. " setaceum, Mx.
44. Panicum gibbum, Ell.
45. " agrostoides, L.
46. " nitidum, Ell.
47. " consanguineum, Kunth.
48. " Crus-galli, L.
49. Setaria viridis, Beauv. Wild Timothy.
50. " macrostachya.
51. Andropogon tener, Kunth.

OCCASIONAL WEEDS.

1. Sida cordifolia, L. Tea weed.
2. Crotalaria incana, D C. Rattle pod.
3. Jussiæa erecta, L.
4. Bœrhaavia erecta, L.
5. Rivinahumilis, L.
6. Acalypha persimilis. Simp.

These lists may serve somewhat as an index to the quality of soil for immigrants, as the Portulacca, Helenium, Ceanothus, Vernonia, Datura, Desmodium, Abutilon and Xanthium, will only thrive in fertile soil, and rarely occur elsewhere, while the Diodia, Rumex, Aristida, Carex, Linaria and Frœlichia, are fully as sure indications of sterile or worn-out land.

I wish, especially, to call the attention of our planters to the list of aggressive weeds, most of which have barely a footing in the State, but are spreading rapidly, and eventually will become formidable. It would certainly be a misfortune beyond measure, if the Nut grass should ever cover our best lands with its almost ineradicable shoots, or the Nettle with its stinging leaves, the Careless weed with its fragile thorns, or the Ipomea tamnifolia with its wiry vines should invade our gardens and groves.

The Nut grass is creeping in from the West, Dog fennel (Maruta) has reached Tallahassee in its southward march.

The Paraguay bur, introduced at Augusta, Georgia, in wool brought from Paraguay, some twenty years ago, has now spread over Florida, and is as far south as Bronson. The Urena is a Cuban plant, but has migrated as far north as Gainesville, Fla.

The Urtica (Nettle), Abutilon (Butterprint), Polygonum (Knotweed), Verbesina (Dogweed), Leonotis (Prickly Mint), Thistle (Cirsium), Fireweed (Erechthites), and Spurge (Euphorbia), are traveling southward, the Aplopappus is extending from Tampa.

I have no doubt further investigation will show the progress of many new weeds from the older States, and possibly from the West Indies; in fact, it is more than probable, that eventually as the land is opened up, cultivated and fertilized, Florida will be the common resort of all the "tramp" plants of the world, attracted, like people, by the genial climate, and mellow soil.

It behooves our farmers, therefore, to be vigilant in repelling these invaders as soon as they appear.

A few of the weeds have a medicinal value, that in some measure tends to reduce their general bad character, and often in domestic practice and mild cases, extemporaneous infusions or decoctions have given the needed relief.

The Bidens, Xanthium, Ambrosia and Eupatorium are tonics; the Sesuvium, Oxalis, Rumex, Urtica, Œnothera and Frœlichia are diuretic; the Cassias, Ipomea, Quamoclit and Pyrrhopappus are laxative.

The Blackroot is sedative and diaphoretic; the Vernonia is stimulant and tonic; the Ceanothus, Croton and Polygonum are astringent.

The Poke is a very valuable remedy in Garget; the Croton is almost a specific in the colic of horses; the Leonotis, Monarda, Daucus, Sisymbrium and Gnaphalium are fair diaphoretics, while the Ambrosia and Chenopodium act as fine tonics for all kinds of stock.

As honey-producing plants, the Partridge pea, Urena and the Tea weeds are quite valuable, and bees find much nectar in the blooms of the Cirsium, Heliophytum, Portulaca, Sisymbrium, Diodia, Capsella, Opuntia, Leonotis and Passiflora. The list of "bee plants" is very incomplete and needs revision.

I include, very reluctantly, the Florida Clover (Desmodium molle) in the list of weeds. It is by far the best green forage plant we have at present, and the cow, sheep, goat, hog or horse that will not recuperate in a field of this weed, is past help from other food. As an improver of soil it is of the greatest value in Florida, and its habit of not appearing until the laying by of the corn crop, is unique, entitling it to a front rank as a beneficial plant. Still, once in a field, it is there to stay, and its tenacious pods at times are very troublesome.

The Crowfoot, Bullgrass, Crabgrass, Bermuda grass and the Paspalums are all classed as weeds, and yet, with little effort, the best of dry forage can be made from these grasses.

Some recent experiments with the Paspalum platycaule (Louisiana grass) indicates that in it there is a fair prospect for the needed pasture grass for Florida. It is a perennial, very thrifty, stands well both drought and rain, is a native grass, and is as nutritious as the best pasture grasses of the North. It deserves an extended trial in all sections of the State.

The Eragrostis Brownei, with a little care and the use of a potassic fertilizer, makes a very pretty lawn for the summer, and is well liked by stock.

Some thousands of acres in Florida, generally around lakes and ponds, are covered with a dense growth of perennial grasses, mostly Paspalum distichum, P. ciliatifolium, P. obtusifolium and P. platycaule, rarely seeding, and forming a nearly perfect sward.

Around the taller tufts of the Paspalums the dainty, velvety Panicum serotinum and the Eragrostis Brownei form a soft, carpet-like growth, much relished by sheep and goats, while the stouter grasses afford fine pasturage for other stock.

Old fields, not too worn, soon are overrun with Rumex Engelmannii, Gerardia divaricata, Ambrosias, Sandspurs, Eragrostis capillaris and the Frœlichia, weeds that eventually give place to Foxtails and the Broomsedge.

Very sterile land is finally covered with the Aristidas and Carices. It is curious to note that it takes about ten years for the Broomsedge to displace the other weeds, except Gerardias and Blackberries, and that the Wire grasses require at least twenty five years to conquer all other growths.

Very few persons have any idea of the number of weeds found on an acre or the labor involved in their removal. In the early part of the year, I removed and counted the separate plants in an average piece of weedy ground, the plat containing seventy-two square feet, 1 605th of an acre. To my surprise, I found ten species and 808 plants; 204 Heleniums, 316 Diodias and 124 Andropogons; the remainder being Partridge peas, Maypops, Horsemints, Ragweeds, Sandspurs, Crabgrass and Horse-nettles. This would be at the rate of 484,000 weeds on an acre. Later on, in August, I again examined the plat, finding fourteen species, and at the rate of 322,500 plants on an acre. The Sandspurs, Crabgrass, Diodias and Ragweeds were in the lead, with the addition to the plants named before, of Jerusalem oaks, Gnaphaliums, Gerardias and Œnotheras.

All these were removed, and in October the plat was again examined; the result was the finding of six species, Sandspurs, Ragweeds Diodias, Maypops, Frœlichias and Broomsedge, and at the rate of 242 000 plants on an acre. These were removed, and the last count in December gave 187,550 plants, Linarias, Gnaphaliums, Sandspurs and the Red weed. The labor required to remove these useless plants by the hoe, in a cotton field, is enormous. Allowing seventy rows to the acre, one foot of surface to be hoed the length of each row, four hoeings during the season, and four strokes to each square foot, gives 235,200 strokes of the hoe to each acre, and if the land is "flat hoed" all over, it takes at least 174,240 strokes to remove the weeds. Comment is hardly needed, as the figures fully justify the inference that clean culture is essential to success in farming in this country.

The seeding capacity of some weeds is enormous. A fully developed Sida will ripen during the season at least 400 seeds, each equipped with two hooks which easily catch onto animals or people and thus are scattered broadcast. An Urena averages 1,000 seeds, the Florida clover about 600 seeds, the Careless weed 1,000 seeds, the Cocklebur usually 200, the first generation of Ragweeds 1,000 seeds, the second about 100 seeds to the plant. Jerusalem oaks ripen from 6,000 to 10,000 seeds in a crop, but fortunately for us, they are the food of a tiny beetle and some of our birds also relish the seed. None of these compare with the Sandspurs. One Sandspur coming into bloom in January, will easily ripen 100 seeds with almost the certainty that there will be 10,000 plants by August, and a million in November, ripening 100,000,000 seeds for an early start the next year.

Rating weeds in order of badness, I would give the Sandspurs the first place. They are bitter grasses eaten only as a last resort by cattle, and all other weeds in the State combined do not cause as much pain, profanity and danger to life, as these worthless grasses Maiden cane follows a long distance in the rear. This is also a bitter grass hard to eradicate, but cut when it is young, makes a tolerable hay. Nut grass ranks third, and, once well established in a field, usually outlives the owner. Tea weeds are fourth, with roots apparently clinched on the other side of the world; then the Maypop, almost a rival of the Nut grass.

Sixth, the Diodia. When young this weed presents its leaves to the four cardinal points of the compass, whence the name I have given it. Other weeds rank in about the following order: Ragweed. Careless weed, Crabgrass, Carrot, Ipomea, Urena, Partridge pea, Fennel, Isopappus, Paraguay bur, Prickly mint, Horse nettle, Bermuda grass. A few weeds enrich the soil. The roots decay or the leaves fall in sufficient quantities to form some humus. The Richardsonia, Cockle-bur, Japan clover and Florida clover are certainly valuable in this respect, but most of the plants in these lists produce neither food, forage nor money crops; they are plants out of place, thieves of time, labor and money—intruders—vagabonds—weeds.

The practical inference is to prevent the weeds from seeding. A crop of oats, followed by peas, and they by several plowings in the late fall, will rid most fields of the usual grasses and annuals. A flock of sheep or goats aid the clearing out of nearly all briars and perennials. The Benne plant (Sesamum), in drills, east and west, will almost alone extirpate the Sandspur.

In general it is best to occupy the ground with a succession of hoed crops, and be vigilant in noting the first appearance of weeds, then destroy them before they bloom.

J. C. NEAL, M. D., *Botanist.*

ANNUAL REPORT OF THE FLORIDA EXPERIMENT STATION.

LAKE CITY, January 1, 1890.

To His Excellency, Francis P. Fleming, Governor of Florida:

SIR—I have the honor to submit the following as the report of the operations of the Florida Experiment Station, and the Teasurer's report, in obedience to the provisions of the act constituting said Station, approved by the President of the United States of America March 2, 1889. I am, your Excellency, yours obediently,

JAMES P. DEPASS, *Director.*

REPORT.

For reasons enumerated in the last Annual Report, the Florida Experiment Station has not yet arrived at that point where good results can be justly expected of it, and, in the main, during the last year, it has steadily confined its work to the preparation of land and arranging for the future. The necessary labor to this end has incurred much expense. Twenty acres of heavy hammock land have been freed from stumps, roots and logs; fifteen additional acres of dense timber have been felled, the logs and limbs piled, and some of the stumps removed; and six acres, that last year were boggy and useless, have been underdrained, and soon will be available for experiments.

A large amount of new fencing has been necessary, and as soon as possible a substantial wire netting will replace some old and decaying wooden fences.

Other needed improvements have been made in repairs to the farm buildings—the addition of sheds, stalls and some outhouses.

Improved labor-saving machinery for planting and harvesting crops has been purchased when needed, and also a small steam-engine to supply the power required.

A small silo was built during the summer of cheap materials and very roughly. This was filled with corn-fodder, pea-vines and grasses, packed tightly without cutting and heavily weighted. It has not yet been opened. This is an experiment which, if successful, will be a guide to further efforts in the direction of cheap forage. If it is a failure, it may show how and where are deficiencies or errors to avoid in the future.

In the Experiment orchard are sixty varieties of peaches, with other fruits; and as fast as possible all the varieties of fruit trees suitable to this section will be placed on trial. Fifty varieties of grapes are in the vineyard, embracing all kinds supposed to be of value in Florida.

The experiments upon most crops were rendered almost or complete failures by the protracted drought, extending from April 30 to May 28. During this period the average temperature was 72° Fahrenheit; not a drop of rain and a brisk breeze. These unusual complications completely destroyed forage crops, strawberries and the Experiment garden, and so damaged the tobacco, rice, oat and corn experiments as to invalidate any conclusion that might be made for them. For the same reasons the experiments with corn and sugar-corn are of no value, except to suggest some directions for the future management of these crops.

A large number of young fruit trees and varieties of forage and vegetable seeds have been distributed to the different sections of the State for testing as to availability and adaptability to various soils, and some study has been made of Florida soils with a view of introducing new forage and food plants. A collection of grass seeds from the south of Europe has been procured, and experiments on the line of acclimating these forage plants will be tried the coming year.

The live stock on the farm now consists of a Jersey bull and four Jersey cows, a Holstein-Friesan bull and cow, four Cotswold and two Southdown sheep, a Hambletonian stallion and mare, two draught horses and two mules.

A number of improved chickens, turkeys, geese and ducks will be added as soon as the yards now in preparation are ready.

It is the intention of the Station to improve the live stock of Florida as far as possible by the use of the Station equipment.

Sub-experiment stations have been located at Fort Myers, Ocala and DeFuniak, but have not become operative, except at DeFuniak.

During the year all letters relating to his department have been answered by the Botanist and Entomologist.

A collection of injurious insects has been begun, and some progress made in a study of the habits of tobacco insects. It has been deemed advisable, however, to continue this investigation during the coming year before publication.

A botanical collection is being prepared, especially of the grasses of Florida. The results of a preliminary study of weeds is hereby annexed.

As soon as the Experiment farm is in condition, we hope to be able to render effective service to the State.

Very respectfully,
JAMES P. DEPASS, *Director.*

LAKE CITY, December 19, 1889.

Rev. James P. DePass, Director Florida Agricultural Experiment Station:

SIR—A brief summary of the work of the chemical department of the Station for the year 1889 is herewith respectfully submitted:

PHOSPHATES.

Eleven specimens of what were thought by the senders to be phosphate rocks have been analyzed. Only four of them proved to be of any value as phosphates. They contained, respectively, 41.30, 20.00, 13.20 and 9.59 per cent. of phosphoric acid—equivalent to 88.19, 43.95, 28.71 and 20.82 per cent. of phosphate of lime. The South Carolina rock contains 55 to 61 per cent. of phosphate of lime.

The seven remaining specimens were found to contain from 2½ per cent. down to scarcely more than a trace of phosphate. They were, in fact, merely limestone, containing from 30 to 95 per cent. of carbonate of lime, with an admixture of sand.

NOTE.—Since writing the above. the analysis of eight specimens from Ocala (presumably from the Dunnellon section) have been finished. One specimen contained 95 per cent. of sand and no phosphate. The others were very rich, ranging from 30 to 37 per cent., and averaging 34 per cent. of phosphoric acid. This is equivalent to 65 (lowest), 81 (highest) and 75 (average) per cent. of phosphate of lime.

FOSSIL REMAINS.

Fossil remains are generally easy to be recognized, owing to their resemblances to bones or tusks. They are rich in phosphate, and, where found in quantity, are very valuable. Three specimens analyzed at the Station contained 49 06 to 78.50 per cent. of phosphate of lime.

LIMESTONE.

Limestone is found in abundance in many parts of the State, and the manufacture of lime could doubtless be profitably engaged in to much greater extent than is at present the case. The stone is of a porous, loose texture, and crumbles easily. The following table will give an idea of the composition of Florida limestone. In most cases only the lime and sand were determined :

	58	57	63	64	86	87	88	94
Moisture at 212°	2.00	1 70	0.41	0.78				
Oxides of Iron and Aluminum		27.40	1 12	0 96				
Lime(Ca O)	55.28	19.20	29 52	43 76	31.68	43.60	18 80	54 60
Magnesia	0.64	0 36	17 96	0.40				
Sulphuric Acid	0 01	0.68	0.33	0 25				
Phosphoric Acid	0.09	2.88	0.06	0 05	0.38	1 14	1.08	0 20
Sand	0 18	45 13	6 77	18.95	6 21	15.07	43 08	0.20

A perfectly pure limestone (seldom or never met with in nature) can contain only 56 per cent. of lime.

OYSTER SHELLS.

Several samples of ground oyster shells have been sent us with inquiry as to their value as fertilizer. Besides a small admixture of sand, they contain 50 to 52 per cent. of lime (equivalent to 90 to 93 per cent. of carbonate of lime). 0.13 per cent. of phosphoric acid, and 0.16 per cent. of potash. A sample of shells, said to be ground up with young oysters, contained 0.27 per cent. of phosphoric acid, 0.20 per cent. of potash, and 90 per cent. of carbonate of lime. This sample showed so little organic matter that it was not thought worth while to determine the small per cent. of ammonia that could be present. Shells have little or no manurial value beyond what is due to their contents of lime; and as to grinding up young oysters, it would seem to be a very extravagant procedure, if they are at all likely to grow to marketable size.

A sample of lime, made from oyster shells, was found to contain a large per cent. of carbonate. This was due to imperfect burning, and detracts greatly from its value as a building material.

GYPSUM.

Two samples of gypsum have been analyzed. They contained 77.45 and 74 per cent. of sulphate of lime. The papers of the State have had a good deal to say of gypsum. Its significance as a fertilizer has been treated of in Bulletin No. 6.

MUCK.

The subject of muck was taken up last summer, and is fully treated in Bulletin No. 7. Eighteen to twenty samples from various parts of the State have been analyzed. By referring to Bulletin No. 7 it will be seen that a hundred pounds of Florida muck contain from one-half to three pounds of ammonia, from less than one-sixth to four-fifths of a pound of potash, and from less than an ounce to three-fourths of a pound of phosphoric acid. Barnyard manure contains, per hundred, about one-half to one pound of ammonia, five ounces to seven tenths of a pound of potash, and one fifth to one-half of a pound of phosphoric acid. From a chemical standpoint, therefore, a good quality of muck is not inferior to barnyard manure. But, as is well known, the plant-food in muck is in a much less available form than that in manure; hence the necessity of weathering and composting muck, in regard to which matter see the Bulletin referred to above.

FERTILIZERS.

Below are given the analyses of nine samples of fertilizers, sent from different parts of the State. The estimate of value per ton is at the rate of 6 cents a pound for available phosphoric acid, 15 cents a pound for ammonia, and five cents a pound for potash. These are the South Carolina rates for the season of 1888–89, are "based on the cash values of the single ton at Charleston, and do not include the cost ot transportation:"

Total Phosphoric Acid	16.53	9.34	6.15	14.00	18.41	11.72	13.48	11.74	12.66
Available Phosphoric Acid	12.28	4.99	.....	6.16	7.79	9.22	2.42	9.18	8.88
Potash	0.66	...	1.97	4.20	3.90	8.85	7.48	1.78	2.00
Ammonia	1.54	10.60	2.53	8.40	8.31	2.76	.....	8.14	5.95
Value per ton	$19.95	$37.78	....	$21.79	$28.18	$28.19	$10.38	$22.22	$30.50

KAINIT AND ASHES.

The following are analyses of kainit, Georgia, Florida and Canada ashes:

	12	13	26	95	96	97	55	25	80
Potash	11.10	12.74	2.44	2.20	4.20	4.00	2.98	2.84	13.39
Total Phosphoric Acid	....	....	1.72	.....	.....	.....	2.08	4.40	3.48
Lime	.	..	36.20		....	....	24.72	36.20	13.04
Value per ton	$11.10	$12.74	$ 5.50	$ 2.20	$ 4.20	$ 4.00	$ 5.42	$ 8.12	$17.56

The phosphoric acid in 95, 96, 97 was not determined, but would be about 1.85 per cent. It is the potash mainly that decides the value of ashes. Nos. 12 and 13 are kainit; 26, 95, 96, 97, Canada hard-wood ashes (said to be unleached); 55, Georgia hard-wood ashes; 25, the ash of Florida hickory, and 80 of Florida moss. Eighty-seven analyses of Canada ashes, made at the Massachusetts Experiment Station, gave 10 24 as the highest, 2.49 as the lowest, and 5.50 as the average per cent. of potash; 3.99, 0.29, and 1 85 as the highest, lowest, and average per cent. of phosphoric acid; 50.89, 18.00, and 34.44 as the highest, lowest, and average per cent. of lime. In the estimate of value phosphoric acid is rated at 6 cents, which is somewhat too high, as the acid here under consideration is the *total* and not the *available*. About $2 20 should be added to the value of 95, 96, and 97 each, for their profitable contents of phosphoric acid.

BIRD DUNG.

Two samples, one from Dunster, Florida, and designated "bat guano," the other from Charlotte Harbor and designated as "dirt from a bird rookery," show 5.12 and 8 20 per cent. of phosphoric acid, and 0.55 and 0.19 per cent. of potash respectively. The "bat guano" was said to have been taken from a cave where there is a considerable deposit. It contained 56 per cent. of organic matter. Both samples are quite valuable as fertilizers.

WATER.

Thirteen or fourteen samples of water have been analyzed, either completely or tested as to their healthfulness There is nothing of special interest to be reported in regard to them, except the remarkable purity, shown by water from a driven well located in the midst of filthy surroundings. Attention is called to this fact, in order to emphasize the superiority of the driven well, as to purity of water, over the old-fashioned dug well. It is amazing that people will persist in the use of open wells, oftener lined with boards than bricks, veritable breeders of musquitoes, frogs and fever—when a driven well, even if not over 20 to 25 feet deep, is infinitely superior and equally cheap, if not cheaper.

SOILS.

It is frequently asserted that potash is *par excellence* the element of plant-food lacking in Florida soil, and special stress is laid on the importance of supplying that element as though other elements could take care of themselves. The number of soils (nine) analyzed do not warrant the drawing of any broad general conclusions—certainly no such one as the above. While some of the soils analyzed are abundantly rich in all the constituents of plant food, a majority show a low per cent., not only of potash but of phosphates also. Deep, sandy soils, however, do not need to have as high per cent. of plant food as clay soils. One of our analyses, that of a virgin hammock, showed a very low per cent. of potash and of phosphoric acid—much lower than the minimum usually considered consistent with fertility. Nevetheless, this hammock is covered with a luxuriant growth of vegetation. As to fertilizing Florida soil, the true method, I believe, is first of all to keep the soil abundantly supplied with vegetable matter (muck, peavines, barnyard manure, etc). In this way ammonia, which is by far the most costly constituent of plant-food, can be largely supplied, and the necessity of resorting to expensive ammoniated fertilizers, to considerable extent, obviated. Where muck is convenient and of good quality, it is especially to be recommended. But having attended to this great need (organic matter) in our sandy soil, not only potash, but phosphates also, should be supplied.

GRASSES.

A number of Florida grasses have been analyzed, and show some points of great interest; but work in this line has scarcely begun. The analyses thus far made need to be re-enforced by others.

J. M. PICKELL, *Chemist.*

BULLETIN No. 9,

OF THE

EXPERIMENT STATION

OF FLORIDA

AT THE

STATE AGRICULTURAL COLLEGE,

LAKE CITY, FLORIDA.

FLORIDA [illegible] STATION.
LAKE CITY, FLA.
FREE.
J. P. De Pass
Bulletin No.
Director.

ENTOMOLOGICAL NOTES. **JAS. C. NEAL, M. D.**

APRIL, 1890.

REV. JAS. P. DePASS, Director.

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Is it possible to extract, mechanically, the phosphate from the low grade rock, producing thus a high grade material?

It is known, of course, that the South Carolina nodules are washed to free them from adhering mud and sand; also, that the phosphatic pebbles of Peace Creek are freed from sand by washing and sifting. But this kind of purification is not what is meant by the foregoing question. There are vast quantities of Florida rock containing 20 to 30 per cent. of phosphate. Can these be free to a great extent from the impurities? Two very simple experiments, resting each on entirely different principles, have been made in our laboratory with a view to answering that question. They were hastily executed, and have not yet been repeated and improved upon; but they show that something can be done in that line with certain kinds of rock. The material experimented with was a coarse grained phosphatic sandstone. A rock which originally contained 23.65 per cent. of phosphate produced 36 per cent. of a material which contained 31.65 per cent. of phosphate, an increase of 8 per cent. of phosphate. Another rock which contained originally 35.33 per cent. of phosphate was separated into several grades, one of which constituted one-tenth of the original rock and contained 56.93 per cent. of phosphate, an increase of 21.63 per cent. It is, doubtless, possible to improve greatly on these results. Reference is had here to purification by *mechanical*, not chemical means.

EXTENT OF DEPOSITS.

Very few persons who sent us samples were able to give any idea of the extent of the deposits. I quote a few replies to inquiries on this point. "The sample of phosphate rock I sent you was found on dry land. I can't tell as to the amount of the deposit, such as I sent was found within three feet of the surface, a little deeper is a pretty heavy deposit of what they call here phosphate clay, which is claimed by some to be very rich." The sample in question contain 76 to 84 per cent. phosphate.

"I am unable to say how large the probable supply is, though we deemed it to exist in sufficient quantities to mine profitably before the find became so extensive." Samples contain 56 to 73 per cent. of phosphate.

"Deposits ranging from a ton to acres and acres."—Content of phosphate, 16 per cent. and 72 per cent.

"Specimen sent you came from river bed, about four to six feet below the level of the pine land. The river has but little swamp or hammock there, and on one side coming down to the river is high rolling pine land,—on the other side is flat level low land (pine) for about 200 to 300 yards from river bed. I do not know yet how deep the deposits may be, but know that it extends same depth from surface as river bed." Content of phosphate, 30 per cent. and 56 per cent.

"Samples one and two taken at a depth of three and one-half to four feet—vein or ledge from eighteen to twenty-four inches, high pine land. No. 3 taken at depth of ten feet, high hammock land.—Seems to be large quantity of all, as boring developed, the ledge extended over two to three acres at depth from three and one-half to ten feet from surface of ground." Content of phosphate (sample 3), 40½ per cent.

"No. 2 I think was a sample taken from a well I have on my place, at depth of about thirty-nine feet from surface, and as we had nothing but a sand-pump, we had to stop after going through that substance nearly two feet About 700 feet east, and I should judge about thirty feet or more below surface where well is, or near, the level of some ponds near, rock crop out at surface in the form of large rocks several feet surface and a foot or more thick. Could not say about extent of deposit, but there seems to be rock all through this section." Content of phosphate, sample No. 2, 67 per cent.

"Sample taken from one hundred boulders and pounded in mortor. This is a fair average hard rock twelve feet thick of twelve pits on 230 acres. * * * * Average depth of sand covering, six feet. * * * * Pine land—high sand hills surrounding county one-half mile from pond." Content of phosphate, 80 per cent.

"Rolling pine land, timber short but heavy in girth, scattering—dry, no swamps or ponds; the tract of eighty acres, I think, contains forty acres or more of phosphate. The sample you had came from a well dug about ten years ago, forty or fifty feet deep; the phosphate rock appears to be about ten feet from top of ground. Could not tell about how thick the vein is. It is about the middle of a phosphate strip running five to seven miles north and south." Content of phosphate, 73 per cent.

"Land rolling, first-class pine, with clay near surface. At the edge of deposit, it has been examined to the depth of near fifteen feet, and there is little change in character of the rock. Surface indications point to the existence of the phosphate over at least sixty or more acres, but it has not been thoroughly examined." Content of phosphate, 74 per cent.

II.

SUPERPHOSPHATE—ITS MANUFACTURE.

As many as four classes of phosphates are known to chemists. The most common class is that of the *ortho-phosphates*. Of these the commercially most important one is tri-calcium phosphate, often called bone phosphate from the fact, doubtless, that it is found in all bones, constituting as much as 40 to 50 per cent. of raw bones and 60 to about 80 per cent. of burnt bones or bone-ash. It was the use of bones as a fertilizer and the manufacture from them of super phosphate that led to the similar utilization of phosphatic rocks. Tri-calcium phosphate is the main phosphatic constituent of guano, coprolites, phosphorites, apatite and the Florida and South Carolina phosphates. The manufacture of super-phosphate is the corner-stone of the fertilizer industry; and brief statement of the underlying principles will be acceptable to all those readers of our bulletins, who are not familiar with the subject.

From tri-calcium phosphate are derived bi-calcium and mono-calcium phosphate. Two or three easily understood chemical formulas will make this clear. The formula for phosphoric acid as commonly used, is $P_2 O_5$; for quick lime $Ca O$; for water $H_2 O$. The meaning of each of these formulas is this: $P_2 O_5$ is a compound consisting of 62 parts of phosphorus and 80 parts of oxygen, together 142 parts. $Ca O$ is a compound consisting of 40 parts of the metal calcium and 16 parts of oxygen, together 56 parts. $H_2 O$ is a compound consisting of 2 parts of the gas hydrogen and of 16 parts of oxygen, together 18 parts. Every reader of this knows, of course, that *phosphorus* is a yellowish, transparent, wax-like substance which will take fire of itself and burn if exposed to the air; also, that in the dark it *phosphoresces* or gives off light. Some matches leave a streak of light on the wall when struck in the dark. This is the phosphorus in them. *Calcium* is a tenacious and maleable metal harder than lead, but only one-seventh as heavy; when heated it burns with a light of blinding brilliancy. It need hardly be stated that *oxygen* is a gas which has neither color, odor nor taste; that it constitutes about one-fifth part of the atmosphere, and is that part of it which, when breathed, supports life, and without which wood or other combustibles will not burn. *Hydrogen* is also a gas without odor, color or taste, and is the lightest of known substances.

Now let us go back to the composition of tri, bi and mono-calcium phosphate. The following diagram will make the composition of each plain:

TRI-CALCIUM PHOSPHATE.		BI-CALCIUM PHOSPHATE.		MONO-CALCIUM PHOSPHATE.	
Phosphoric acid, P_2O_5,	142 parts.	Phosphoric acid, P_2O_5,	142 parts.	Phosphoric acid, $P_2 O_5$,	142 parts.
Lime, CaO,......	56 "	Water, H_2O,........	18 "	Water, H_2O,.........	18 "
Lime, CaO,......	56 "	Lime, CaO,..........	56 "	Water, H_2O,.........	18 "
Lime, CaO,......	56 "	Lime, CaO,..........	56 "	Lime, CaO,..........	56 "
Total............	310 "		272 "		234 "

Tri-calcium phosphate is composed of phosphoric acid and three equivalents of lime. Bi calcium phosphate differs from this in that it contains only two equivalents of lime, water taking the place of the other equivalent. In mono calcium phosphate only one equivalent of lime remains, water having displaced the other two. Tri-calcium phosphate is a white substance scarcely at all soluble in pure water. But if the water holds in solution nitrate of soda, common salt, ammoniacal or other salts, or carbonic acid, it will be to some extent dissolved. The water in the soil contains all these ingredients. Hence it is that plants have the power of absorbing even tri-calcium phosphate; still, however, the solubility is so small that the process of absorption is slow. Bi-calcium phosphate is more soluble than the tri, and the mono is easily, readily and completely soluble, and is immediate and rapid in its action on plant growth.

The manufacture of superphosphate (sometimes called acid phosphate) consists in the conversion of tri-calcium phosphate into mono-calcium phosphate. This conversion is brought about by the agency of acids. Formerly muriatic acid was used, but its use has been abandoned for the reason, among others, that one of the products of its action on the tri-calcium phosphate, calcium-chloride, has been found injurious to plants. Sulphuric acid is now almost universally used. Its action on pure tri-calcium phosphate may be illustrated by the following scheme:

A.

Tri calcium phosphate	310	parts	give	Mono-calcium phosphate	234	parts.
Require Sulphuric acid	196	"		Calcium sulphate (Land plaster or gypsum).	272	"
Total	506	"		Total	506	"

—or—

B.

Tri-calcium phosphate	100	parts	give	Mono-calcium phosphate.	75.48	parts.
Require Sulphuric acid	63.22	"		Calcium sulphate	87.74	"
Total	163.22	"		Total	163.22	"

It will thus be seen that every 75.48 pounds of superphosphate, even if made from perfectly pure tri-calcium phosphate, must of necessity contain 87.74 pounds of calcium sulphate or anhydrous gypsum, or, to express it in hundreds, the purest commercial superphosphate must contain 53.75 per cent. of calcium sulphate and can contain only 46.25 per cent. of mono-calcium or superphosphate. As a matter of fact, however, they seldom or never contain more than 16 to 25, possibly 32 per cent.; this results partly from the fact that the material (rock or bone) from which the superphosphate is manufactured, contains impurities, and partly from the fact that the superphosphates themselves are purposely diluted.

As scheme B shows, 100 pounds of pure tri-calcium phosphate require 63.22 pounds of pure sulphuric acid for its complete reduction. In practice, however, the quantity of acid necessary to reduce 100 pounds of rock depends on the quantity of phosphate and on the quantity and nature of the impurities in the rock; that is, one must have an analysis of the rock in order to know how much acid to use. The impurities commonly occurring are carbonate of lime and magnesia, oxides of iron and aluminium, and calcium fluoride. The phosphate will not be reduced completely unless enough acid is used to reduce these impurities also. As the products of this reduction add nothing to the commmercial value of the superphosphate, the acid consumed by the impurities is just so much unavoidable loss. (It should be stated that a small amount of carbonate of lime is beneficial, in that the gas, liberated from it by the action of the acid, tends to give a sponginess and lightness to the superphosphate, thereby enabling it to dry more thoroughly and speedily.)

The following scheme will show how much acid is consumed per 100 pounds by each of the impurities under consideration. The acid in all estimates in this article is supposed to be pure (100 per cent.). In practice this is never true; the acid itself will contain as high as fifty per cent. of impurities (mostly water), and this must be taken into account.

C.

100 lbs. each of			Calcium Sulphate. lbs.	Water. lbs.	Carbondioxide (gas). lbs.	Hydrofluoric Acid (gas). lbs.	Ferric Sulphate. lbs.	Aluminium Sulphate. lbs.
Ferric oxide	require 183.8 lbs. Sulphuric acid.	Produce	.....	33.8	....	....	250	.....
Alumina	" 288.3 " " "		.....	52.9	....	....	....	335.3
Calcium carbonate	" 98.0 " " "		136	18.0	44	....	....	.....
Magnesium "	" 116.6 " " "		142.8	21.4	52.4	....	....	.....
Calcium fluoride	" 125.6 " " "		174.3	....	....	51.3	....	.....
Sand and insoluble matter	" none " " "		.....	....	....	....	....	.....

THE QUANTITY OF ACID NECESSARY TO REDUCE ANY GIVEN ROCK WHOSE ANALYSIS IS KNOWN.

This can be easily calculated from the foregoing data. The following table is a special case given as an illustration. (No allowance is made here for the impurities of the acid.) If the acid contained 25 per cent. of impurities, one-third would have to be added to the weight of acid given in the table.

NUMBER OF POUNDS OF THE DIFFERENT CONSTITUENTS IN 100 LBS. OF ROCK.		Acid required by each constituent.	RESULTS OF THE ACTION OF THE ACID ON THE ROCK.								
			Water.	Carbondioxide (gas).	Hydrofluoric Acid (gas).	Calcium Sulphate.	Ferric Sulphate.	Aluminium Sulphate.	Superphosphate.	Sand and insoluble matter.	Organic and volatile matter.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs	lbs.	lbs.
Water	2.65 lbs.	none	2.65	....	....	....	....	....	....	....	....
Organic and volatile matter	1.82 "	unknown	....	....	....	....	....	....	....	....	1.82 ?
Sand and insoluble matter	0 38 "	none	....	....	....	....	....	....	....	0.38	....
Ferric Oxide	0.48 "	0.88	0.16	....	....	....	1.20	....	....	....	....
Alumina	2.96 "	8.52	1.59	....	....	....	....	9.90	....	....	....
Calcium carbonate	3 41 "	3.33	0.61	1.49	....	4.60	....	....	....	....	....
Calcium fluoride	1.86 "	2.37	....	....	0.95	3 24	....	....	....	....	....
Tri-calcium phosphate	86.45 "	54.46	....	..	....	75.70	....	....	64.5	....	....
Totals	100.00 "	69.56	5.01	1.49	0.95	83.54	1.20	9.90	64.5	0.38	1.82 ?
Grand total (acid and rock)		169.56	168.79.								

It will be thus seen that the theoretical quantity of acid necessary to reduce 100 pounds of this particular rock is sixty-nine and one-half pounds. In practice it is usual to take less than the theoretical quantity, so as to be sure that there be left over, in the superphosphate mixture, no free unconsumed acid which would be injurious to vegetation.

It will be further seen that of these sixty-nine and one-half pounds only fifty-four and one-half pounds are consumed in the reduction of the phosphate, the remaining fifteen pounds (or 21½ per cent. of the whole) goes to the impurities. It will also be observed that the sand and insoluble matter consume no acid and are not changed by it. The amount of acid consumed by the organic matter depends on the nature of the organic matter and can be determined only by actual trial.

It will be further noticed that the product of the action of acid on the rock is a mixture, containing superphosphate, calcium sulphate (or land plaster), water, sand other substances.

The weight of this mixture in any particular case is theoretically equal to the weight of the rock and acid together; but in practice this will not be the case, for the following reasons:

The carbondioxide and hydro-fluoric acid are gases and will pass off into the air.

The calcium sulphate and aluminium sulphate have the power of absorbing and chemically combining with water. This water they will take up from the atmosphere, even though they be stored away in a dry place under shelter. In addition to this, almost all substances, particularly such as are in a fine powdry condition, have the power of absorbing from the atmosphere, and mechanically holding, moisture.

Making due allowance for all these sources of uncertainty, our 100 pounds of 86 per cent. phosphate rock, acted upon by sixty-nine and one-half pounds of acid, would result in a mixture weighing not far from 200 pounds. Of the 200 pounds, sixty-four and one-half pounds (or 32.25 per cent.) is superphosphate, seventy-six pounds (or 37.5 per cent.) is calcium sulphate or land plaster.

Commercial superphosphates are of necessity a *mixture* of *mono-calcium phosphate* and *gypsum*, and *usually* also of *other compounds*; even if made from an ideally pure rock (100 per cent. rock)—a condition never attained and not desirable—they cannot contain over 46.25 per cent. of superphosphate. In reality, however, superphosphates in the trade, sold as fertilizers, contain only about 8, 10 to 15, rarely 20 per cent., of soluble phosphoric acid, equivalent to 14, 16, 25 to 32 per cent. of mono-calcium or superphosphate.

OXIDES OF IRON AND ALUMINIUM—THEIR EFFECTS ON SUPERPHOSPHATES.

The presence of these oxides in any considerable quantity is regarded, as is well known, very detrimental to phosphate rock. Why is this? In order to answer this question, we must first get an understanding of what is meant by reversion.

The differences (see page 18) between tri-calcium, bi-calcium and mono-calcium phosphate have been explained. Among those differences that of solubility is the most important in an agricultural point of view. The mono calcium is easily soluble in water. the bi-calcium scarcely at all so, and the tri-calcium still less so. The manufacture of superphosphate, as already pointed out, consists in the conversion of the tri-calcium or bone phosphate into mono-calcium or soluble phosphate. It was long ago observed that superphosphates have a tendency to deteriorate, and in most cases do actually deteriorate, become, that is, less soluble than when first made. The explanation of this fact is that the mono calcium phosphate goes back, or *reverts* into bi-calcium phosphate. Hence it is that the latter is often called "reverted" The reversion can under proper conditions become complete.

There are several explanations of the cause of this reversion. In the first place, if mono-calcium and tri-calcium phosphate come into intimate contact, they react on one another, producing bi calcium phosphate. The mono-calcium extracts from the tri-calcium and appropriates to itself one equivalent of lime, thus becoming bi caclic and reducing the tri-calcic to the bi-calcic form. Thus:

$$\underbrace{\begin{array}{c}\left.\begin{array}{l}CaO\\CaO\\CaO\end{array}\right\}P_2O_5\\ \text{Tri-calcic phosphate}\\ \text{310 parts.}\end{array}\quad\text{and}\quad\begin{array}{c}\left.\begin{array}{l}CaO\\H_2O\\H_2O\end{array}\right\}P_2O_5\\ \text{Mono-calcic phosphate}\\ \text{234 parts.}\end{array}}_{\text{544 parts.}}\quad\text{give}\quad\underbrace{\begin{array}{c}\left.\begin{array}{l}CaO\\CaO\\H_2O\end{array}\right\}P_2O_5\\ \text{Bicalcic phosphate}\\ \text{272 parts.}\end{array}\quad\text{and}\quad\begin{array}{c}\left.\begin{array}{l}CaO\\CaO\\H_2O\end{array}\right\}P_2O_5.\\ \text{Bicalcic phosphate}\\ \text{272 parts.}\end{array}}_{\text{544 parts.}}$$

(It will be remembered that Ca O stands for lime, H_2 O for water, and P_2 O_5 for phosphoric acid.)

In the manufacture of superphosphate an excess of acid must be avoided. Hence it will happen that a small amount of tri calcium phosphate will quite likely remain over unreduced for lack of acid; and being intimately mixed with the mono calcium phosphate will cause the reversion just explained. If the manufacturer possesses sufficient knowledge and skill, he can, and will, reduce this cause of reversion to a minimum.

A second cause of reversion is the action of lime, or also the carbonate of lime, on the mono-calcium phosphate, thus:

$$\underbrace{\begin{array}{c}\left.\begin{array}{l}CaO\\H_2O\\H_2O\end{array}\right\}P_2O_5\\ \text{and}\\ \left.\begin{array}{l}CaO\\H_2O\\H_2O\end{array}\right\}P_2O\\ \text{Monocalcium phosphate.}\\ 234\\ \underline{234}\\ \text{468 parts}\end{array}\qquad\begin{array}{c}CaO\ CO_2\\ \\ CaO\ CO_2\\ \text{Calcium Carbonate.}\\ 100\\ \underline{100}\\ \text{200 parts}\end{array}}_{\text{668 parts.}}\quad\text{give}\quad\underbrace{\begin{array}{c}\left.\begin{array}{l}CaO\\CaO\\H_2O\end{array}\right\}P_2O_5\\ \text{and}\\ \left.\begin{array}{l}CaO\\CaO\\H_2O\end{array}\right\}P_2O_5\\ \text{Bi-calcium phosphate.}\\ 272\\ \underline{272}\\ \text{544 parts}\end{array}\qquad\begin{array}{cc}\multicolumn{2}{c}{H_2O.CO_2}\\ \\ \multicolumn{2}{c}{H_2O.CO_2}\\ \multicolumn{2}{c}{\text{Water and Carbon-dioxide}}\\ 18 & 44\\ \underline{18} & \underline{44}\\ \text{36 parts} & \text{88 parts}\end{array}}_{\text{668 parts.}}$$

The reversion caused by lime never takes place, of course, in the superphosphate heap of the acid works, for the reason that there is no lime left after the action of the acid. The lime, or carbonate of lime, is all converted into sulphate of lime, which does not react on mono-calcium phosphate. This reversion, therefore, is not one that concerns the manufacturer, but does concern the farmer. *Lime should never be composted with super or acid phosphates* unless for some special reason it is the object of the farmer to convert the superphosphate into the less soluble precipitated phosphate. All productive soils contain lime, and necessarily, of course, reversion will take place there, not however, perhaps, till the soluble phosphate has been thoroughly spread throughout the soil.

We now come to a third cause of reversion, namely, the presence of iron and aluminium. This is the most serious of all, because there is no remedy. These elements will generally be present in the rock as oxides, but sometimes also as phosphates. The iron may be present also as sulphide (iron pyrites), but in this form is regarded harmless. The iron and aluminium unite with the superphosphate and form phosphates of iron and aluminium, which are *exceedingly insoluble* compounds. Hence the especially injurious effects of iron and aluminium.

WHAT IS THE GREATEST AMOUNT OF IRON AND ALUMINIUM PERMISSIBLE IN A ROCK?

This is a question that is constantly being asked. I am not aware that any fixed amount can be settled upon beyond which these elements are fatal. Even the smallest quantity of them is to that extent injurious. One part by weight of sesqui-oxide of iron can cause the reversion of 1.45 to 2.2 parts of superphosphate; and one part of oxide of aluminium, 2.28 to 6.8 parts. From this it follows that 3 to 4 per cent. of oxide of iron and 2 to 3 per cent. of the oxide of aluminium can cause the reversion of 4.3 to 8.8 and 4.5 to 20.4 per cent. of superphosphate. But it should be remembered that what is 2 per cent., 3 per cent., 4 per cent in the crude rock becomes only about two thirds that amount in the finished superphosphate; therefore, instead of "4.3 to 8.5 and 4.5 to 20.4 per cent." we should say "about 2.6 to 5 and 3 to 13 per cent." These estimates are, of course, very uncertain; depending, among other things, on how well the superphosphate dries out in each particular case. In Table IV are given some superphosphates manufactured on a very small scale in the laboratory. During a period of fifty days only one sample reverted to the extent theoretically possible according the above estimates. It perhaps rarely happens that the amount of reversion theoretically possible actually takes place. No. 107, which contains very nearly twice as much alumina as 183, suffered only a little over half as much reversion. In many cases 6 or 7 per cent. of alumina would not prove fatal.

It should be borne in mind that what is here said of the detrimental effects of iron and aluminium is meant to apply to superphosphates only. Where the crude rock is used direct as a fertilizer without treatment with acid, the presence of iron and aluminium seems to make little difference.

HOW LOW A GRADE OF ROCK WILL IT PAY TO WORK?

This is another question often asked. It is one of great practical importance. For while there is doubtless great abundance of high grade rock in the State, there are also, it would seem, vast deposits of low grades, running up to 30 to 40 per cent. of phosphate. It is important to know if this low grade rock can be worked. The question cannot be answered definitely. Accessibility to railroad or water transportation, ease or difficulty of mining, etc., effect the question. But these are not the only things to be considered. The kind of impurities contained in the rock also effect the answer to the question. Take for example a rock containing 30 per cent. of phosphate. Whether or not it will pay to work such a rock manifestly depends largely on what the remaining 70 per cent. consists of. A 30 per cent. rock is theoretically capable of producing a superphosphate containing 14 to 18 per cent. of the mono-calcium (or water soluble) phosphate, equivalent to 8 to 11 per cent. of soluble phosphoric acid, and this is but little below the average standard of commercial superphosphates. If, however, as is likely to be the case in low grade rock, there is 3 or 4 per cent. of ironoxide and alumina present, the question of reversion comes in. But supposing iron and aluminium absent, whether the impurity is mostly sand or mostly lime makes a great difference in the cost of manufacture. Suppose two cases; first, the rock contains 30 per cent. of phosphate and 70 per cent. of sand; secondly, the rock contains 30 per cent. of phosphate and 70 per cent. of carbonate of lime. The amount of acid necessary in the two cases, for the complete reduction of the phosphate, will differ greatly.

First case:

30 lbs. of phosphate requ're	18.9 lbs. acid	give	Soluble phosphate	22.65 lbs.
70 lbs. of sand	" none		Calcium Sulphate	26.32 lbs.
			Sand	70.00 lbs.

Second case:

30 lbs. of Phosphate require	18.9 lbs. acid	give	Soluble phosphate	22.65 lbs.
70 lbs. of Calcium carbonate require	68.6 lbs. acid		Calcium sulphate	121.52 lbs.
	87.5		Carbon dioxide	30.80 lbs.
			Water	12.60 lbs.

In each case the same amount (22.65 pounds) of soluble phosphate is produced, equivalent to 13.6 lbs. of soluble phosphoric acid, worth, at eight cents a pound, $1,09. In the first case nineteen pounds of acid, worth about 38 cents, are required; in the latter case over four and one-half times as much acid, worth $1.75. In the first case a more concentrated goods, containing as much possibly as 18 per cent. of soluble phosphate, is made, equivalent to 11 per cent. of soluble phosphoric acid; in the latter case the finished product could hardly contain more than 14 per cent. of soluble phosphate, equivalent to 8 per cent of soluble phosphoric acid. In the first case the principal diluent is sand, worthless, of course, as a fertilizer; in the latter, gypsum or land plaster, which, on clay soils in particular and on all soils deficient in lime, has a certain fertilizing value.

A ton of the first goods, containing, say, 220 pounds of soluble phosphoric acid, would be worth, at eight cents a pound, $17.60; the acid to make it, 253 pounds at two cents, costing $5.06. A ton of the second, containing, say, 160 pounds of soluble phosphoric acid, would be worth $12.80; the acid to make it, 782 pounds, costing $15.64. This is a supposed case intended for illustration. In actual practice, it would rarely, perhaps never, happen that a 30 per cent. rock would produce an 11 per cent. or even 8 per cent. goods. (See table IV.)

It must be borne in mind that what is said here is merely thrown out as a "pointer", and that in practice the value of each kind and grade of rock must be determined by actual experiment. We hope during the coming winter to investigate these and many other practical points in superphosphate manufacture, as applicable to Florida rock.

THE PURIFICATION OF LOW GRADE ROCK BY CHEMICAL MEANS POSSIBLE.

In a previous paragraph, the possibility of purifying low grade phosphate rock by mechanical means was touched upon. A chemical process of accomplishing this result has been successfully practiced in Europe. In the great alkali works, hydrochloric (muriatic) acid is made as a waste, or by product, accumulates in vast quantities, and becomes a drug on the manufacturer's hands. This acid has been used in the reduction of low grade phosphate. The weak solution of monocalcium phosphate thus produced is treated with milk of lime, which precipitates the phosphate as bi-calcum phosphate. This known as "*precipitated phosphate.*" It is in the form of an exceeding fine powder, finer than can be turned out by the best powdering machine, and hence has a value approaching that of mono calcium or superphosphate.

IS IT PRACTICABLE FOR THE FARMER TO MANUFACTURE HIS OWN SUPERPHOSPHATE?

Where there are large deposits of rich rock they will, of course, be worked up by regular manufacturers; but there is, doubtless, much rock of good quality scattered in pockets in comparatively small quantity broadly over the State. On many farms deposits of this kind will be found. The quantity is too small to justify the erection of large works, but sufficient to supply the wants of the individual farm for years. It is certainly of vastly great importance that the farmer be able to utilize this rock. It is in reference to such deposits that the question is asked. As is known, the rock must, by some means or other, be gotten into a comparatively fine powder before the acid is applied. This is accomplished by the large manufacturers by running the rock through ore crushers, then, in cases where necessary, through burstone mills geared very much after the manner of wheat or corn mills. The finer the powder the more quickly and completely will the acid do its work. In the case of the farmer, however, where celerity of work is not so absolute a desideratum, coarser powder could be used, and the acid allowed to work upon it correspondingly longer. Small ore-crushers, to be geared to engines or horse power, can, doubtless, be had at prices within the means, if not of a single farmer, certainly of a neighborhood. Moreover, much of the Florida rock is so soft that even with a hammer and a hard maul a ton or two a day could be reduced by a single man to a comparatively fine state. This might be further improved by sifting. The acid can be applied to the rock in a wooden box lined with sheet-lead. The box may be of any convenient size, ten or twelve feet long, four or five feet wide, and one to two feet deep. The bottom of this should be covered with a certain known number of gallons of water, then sulphuric acid poured in carefully and exceedingly slowly, for great heat will be generated. As the acid is being poured in the contents of the box should be constantly stirred with a wooden paddle. *The water should never be poured into the acid, but the acid always into the water*, otherwise a dangerous explosion may occur. The quantity of the acid to be mixed with a given quantity of water depends on the strength of the acid. After the acid and water are thoroughly mixed and have somewhat cooled down, then a known weight of pulverized rock, depending on the amount of acid put into the box and on the grade of the rock, should be shoveled in spadeful by spadeful and constantly stirred with a wooden hoe. If the rock contains considerable carbonate of lime, strong foaming up will take place as the rock is added to the acid. The mixer should never breathe the gases that rise from the box; he should stand in such a position in reference to the wind that the fumes will be blown away from him. If the rock contains any fluoride of calcium, hydrofluoric acid, a volatile, invisible gas of most active and violent properties, exceedingly dangerous to breathe, passes off in the fumes. The mixture should be allowed to stand an hour or two in the box, then shoveled out and preserved for two or three months under shelter, when it will be ready for use. The superphosphate will sometimes harden upon standing, and will have to be pulverized before fit for use.

The greatest difficulty in the way of manufacturing superphosphate in this small way is, that the farmer cannot know, without chemical analysis, whether or not his rock contains enough phosphate, and not too much iron, aluminium and lime to justify his working it.

In a future bulletin we hope to have something of a more practical kind, based upon experiments, to say on this subject. It is touched on here merely to show the difficulties in the way.

Even if he cannot manufacture his rock into superphosphate, there is no reason why he should not utilize it in the form of fine powder (the "floats" of the trade).

III.

PHOSPHATE AS A FERTILIZER.

Is phosphate alone sufficient to keep up the fertility of the soil?

It would seem superfluous to ask that question. One need, however, only to recall much that has appeared in the newspapers within the last few months to be convinced that such is not the case. There is apparently a wide-spread belief, at least one not infrequently hears remarks to that effect, that nothing further is needed for our poor sandy lands than phosphate.

Chemical analysis of plants has shown always and invariably the presence of the following constituents:

Water (oxygen hydrogen), Carbon, Phosphoric acid, Nitrogen,
Potash, Lime, Magnesia, Ferric Oxide,
Sulphuric acid, Chlorine, Soda, Silicon.

A number of other constituents are sometimes met with. Numerous experiments have demonstrated that plants can grow and thrive without either of the last three constituents (Chlorine, Soda, Silica), but no plant can grow, if even a single one of the remaining nine are lacking. The writer has seen growing side by side in different pots two stalks of corn, one of which was a magnificent specimen of luxuriant growth, the other only a few inches high and withering away. The only difference in the treatment of the two was that the former was supplied with all the elements of plant-food, whereas the latter had all except a few drops of a solution of iron—hardly sufficient in quantity to be weighed. The withholding of any other element of plant-food produces similar results.

It will thus be seen, therefore, that phosphate will be of no avail unless the soil already has a sufficiency of all the other elements of plant-food, or unless they are supplied in case the soil hasn't them. Ville, the great French agriculturist, regards phosphate, nitrogen, potash and lime as constituting a *complete* fertilizer, that is containing all the elements of plant-food that need be supplied by man; this he does on the ground that all the other constituents are always, with rare exceptions, found abundantly present in the soil and in the atmosphere.

THE RELATIVE MANURIAL VALUE OF SUPERPHOSPHATE, RAW GUANO, STEAMED BONEMEAL, COPROLITE POWDER AND THOMAS PHOSPHATE.

Numerous experiments to determine the relative manurial value of the foregoing forms of phosphate have within the last ten years been made by Prof. Wagner at Darmstadt, Germany. Only one series of those experiments is at my command—that with wheat; but as the others gave similar results, this one will serve as an illustration. The average of many experiments are given in the subjoined table. The increased production, caused by superphosphate, over the product of the unmanured plots, is set equal to 100; and the increase caused by the other forms of phosphate is compared with this.

KIND OF MANURE.	Pounds per acre of Phosphoric Acid.	Comparative increase of production, the increase due to superphosphate being put equal to 100.
Superphosphate	44	100
Raw Guano	88	33
Steamed Bone Meal	110	10
Coprolite Powder	110	9
Thomas Phosphate I	88	65
" " II	88	59
" " III	176	13

Pounds per acre here mean net pounds of phosphoric acid; for example, if the superphosphate used contained, say, 22 per cent. of soluble phosphoric acid, then in order to get 44 pounds to the acre, 200 pounds per acre of the gross phosphate would have to be used, and soon for the other manures.

The phosphoric acid in the coprolite powder is in the same form as that in the Florida rock, and what is true of the former may be taken as true—at least approximately—of the latter. In those experiments 110 pounds of insoluble phosphoric acid in coprolite powder show less than one-tenth the manurial value of 44 pounds of the soluble acid in the form of superphosphate. At 2 cents a pound, the former will cost $2.21, and at 8 cents the latter $3.52 (These are the trade rates for Florida.) There is this point to be considered, however,—particularly in the case of light sandy soils poor in lime—the superphosphate will do its work mainly the first year. In case of the powdered rock, the effects would naturally be more lasting. This is an interesting point and needs to be experimented upon on Florida soil and with Florida crops. Thomas phosphate (or Thomas slag) is a by-product of steel manufacture. Preparatory to manufacturing steel, the ore is by a process of oxidation freed from phosphorus which goes into the slag. This slag contains an average of about 17 per cent. of phosphoric acid. In England alone more than 100,000 tons are produced annually. According to Wagner's experiments it stands second to superphosphate in manurial value. It will be noticed that three grades are used,—I. fine dust; II. fine powder; III. coarse powder; and that the manurial value is directly proportional to the degree of fineness. This is true of bonemeal and rock powder. Those, therefore, who prepare powdered rock for home, or other, consumption should take note that the finer the powder the better.

PROF. MAREK'S EXPERIMENTS.

The results of a large number of experiments by Prof. Marek, of the University of Koenigsburg, Germany, extending over the years 1886-'87-'88, and including every kind of soil and numerous kinds of plants, have just been published in book form. These experiments had for their object the determination of the relative manurial value of insoluble phosphate in Peruvian guano, coprolite powder, bone meal, Thomas phosphate. Below is given an extract or two from his tables. In these estimates the product of the not-manured plots is set equal 100, the increase of the manured plots over this is expressed in per cent. It is to be regretted that super (or soluble) phosphate was not included in these experiments.

1. SANDY SOIL.

	OATS. Fertilized in the spring.	POTATOES (Irish). Fertilized in the spring.
a. Coprolite powder	12 per cent.	35 per cent.
b. Peruvian guano	22 " "	13 " "
c. Thomas phosphate	18 " "	16 " "
d. Bone meal	6 " "	16 " "

2. FERTILE LOAM.

	PEAS.	SUGAR BEETS.	POTATOES (Irish).
Coprolite powder . .	30 per cent.	9 per cent.	7 per cent.
Peruvian guano . .	10 " "	13 " "	5 " "
Thomas phosphate . .	38 " "	8 " "	6 " "
Bone meal	44 " "	9 " "	15 " "

3. POOR LOAM.

	BARLEY.	OATS.	POTATOES (Irish).
Coprolite powder . .	2 per cent.	3 per cent.	24 per cent.
Peruvian guano . . .	12 " "	51 " "	27 " "
Thomas phosphate . .	5 " "	23 " "	3 " "
Bone meal	7 " "	21 " "	9 " "

	MUCK OR PEAT SWAMP.	HUMUS SOIL.	
	4. OATS.	5 BARLEY.	6. CARROTS.
Coprolite powder . .	30 per cent.	25 per cent.	25 per cent.
Peruvian guano . . .	36 " "	19 " "	46 " "
Thomas phosphate . .	18 " "	4 " "	20 " "
Bone meal	26 " "	6 " "	38 " "

In the experiments 1, 2, 4, 6, the following quantities of fertilizers were used per acre, and half these amounts in 3 and 4: Nitrogen 44 pounds, phosphoric acid 176 pounds, potash 88 pounds, slaked lime 182 pounds.

The point of interest is that coprolite powder (or ground phosphate rock) shows very considerable manurial value, particularly on sandy soil and soil rich in peat, muck and humus.

Experiments are not wanting which show that rock phosphate, even when in the form of phosphate of iron and aluminium, is to very considerable extent soluble in humic acid; that this solvent action is diminished or entirely prevented when *lime* is mixed with the phosphate. The reason of this latter fact is not far to find. The lime being more easily acted upon, appropriates to itself and neutralizes the acid, thus giving it no chance to act on the phosphate. Ground phosphate rock is especially to be recommended for soils rich in humus and muck or peat, and therefore for bringing fresh and *sour* lands into condition. It would quite likely pay to compost it with muck and barnyard manure, but, for the reason just given, lime should not form a part of these composts.

VOELCKER'S EXPERIMENTS.

The following field experiments by Voelcker are quoted by Storer as showing the value of finely ground natural phosphates, "even on rich soils:"

EXPERIMENTS WITH OATS ON MODERATELY HEAVY LAND.

FERTILIZERS ON ACRE.	CROP FROM ACRE.	
	GRAIN (bushels).	STRAW (tons).
6½ cwt. ground coprolites.	65	1 3-5
5 " coprolites treated with sulphuric acid (superphosphate) . .	72½	2
10 cwt. ground redonda phosphate,	78¾	2
3½ " bone meal with sulphuric acid	61⅓	2
4½ cwt. precipitated phosphate . .	66	1 9-10
No manure	60	1¾
3 cwt. raw bone meal	61 1-5	1 3-5
20 tons dung	70 2-5	2 1-10
10 " " and 5 cwt. coprolites with sulphuric acid	67	2
10 tons dung and 6½ cwt. ground coprolites	62¾	2
5 tons of chalk	72	2 1-7
3 " caprolites with sulphuric acid and 2½ cwt. Peruvian guano . .	64¾	2

EXPERIMENTS WITH PEAS ON LIGHT LAND.

FERTILIZERS ON ACRE.	CROP FROM ACRE.	
	GRAIN (bushels).	STRAW (tons).
No manure	39	2 1·7
5 cwt. ground coprolites	42	2¼
5 " ground coprolites treated with sulphuric acid (superphosphate),	44½	3
5 cwt redonda phosphate	43⅓	2½
4 " precipitated phosphate . . .	40½	2½
3 " bone meal	43½	2 1·7
3 " " " treated with sulphuric acid	42¾	2½
3 cwt. coprolites treated with sulphuric acid and 2½ cwt. Peruvian guano	43	2½

On these particular soils and for these particular crops, it would seem that the increase production due to superphosphate over that of the natural phosphates is so small as to hardly justify the expense of manufacture.

The high value of Redonda phosphate is especially to be noted. This phosphate contains scarcely any lime, but consists almost wholly of phosphate of alumina, and would be valueless for manufacture into superphosphate. This kind of rock is by no means valueless as a fertilizer, however.

MAREK'S FORMULAS.

The fertilizers used in Marek's experiments, quoted above, were compounded according to the following formulas. They may be suggestive and useful, and we therefore give them :

	CONTAINING:			
	Nitrogen. lbs.	Phosphoric Acid. lbs.	Potash (K_2O). lbs.	Lime (CaO). lbs.
NO. 1. COPROLITE FERTILIZER.				
1006 lbs. Coprolite meal		220		314
640 " Sulphate of ammonia	55			
220 " " " potash			110	
200 " Slaked lime				140
NO. 2. STEAMED BONE MEAL.				
1008 lbs. Steamed bone meal	46.0	220		273
44 " Sulphate of ammonia	8.8			
220 " " " potash			110	
250 " Slaked lime				182
NO. 3. THOMAS PHOSPHATE.				
1058 lbs. Thomas phosphate		220		455
275 " Sulphate of ammonia	55			
220 " " " potash			110	
NO. 4. PERUVIAN GUANO.				
1155 lbs. Peruvian guano	48	220	40	81
33 " Sulphate of ammonia	66			
140 " " " potash			70	
497 " Slaked lime				374

The lime in these formulas is added in order to equalize that constituent in all the fertilizer; it would, of course, not be used in a formula of which superphosphate forms a part.

WAGNER'S FORMULAS.

Wagner recommends the following combinations of superphosphate, potash and nitrogen. The numbers indicate pounds per acre, and is a medium application :

FOR TOBACCO.

Soluble phosphoric acid, 36 pounds, or 180 pounds of a 20 per cent. superphosphate.

Potash, 72 pounds, or 360 pounds of a 20 per cent. sulphate of potash.

Nitrogen, 16 pounds, or 135 pounds of nitrate of soda.

FOR CEREALS.

Soluble phosphoric acid, 45 pounds, or 225 pounds of a 20 per cent. superphosphate.

Potash, 45 pounds, or 90 pounds of a 50 per cent. chloride of potash.

Nitrogen, 22 pounds, or 180 pounds of nitrate of soda.

FOR PEAS, BEANS AND OTHER LEGUMINOUS PLANTS.

Soluble phosphoric acid, 45–55 pounds, or 220–270 pounds of a 20 per cent. superphosphate.

Potash, 62–70 pounds, or 310–350 pounds of a 20 per cent. kainit.

Nitrogen.—Very little, if any, nitrogen need be applied. Leguminous plants contain more nitrogen than any others, and it would seem that they, of all others, should be most bountifully supplied with that element. But this is not the case. They are endowed, as numerous experiments have demonstrated, with the remarkable power of themselves getting their nitrogen to a large extent from the atmosphere.

FOR POTATOES (IRISH).

Soluble phosphoric acid, 27 pounds, or 135 pounds of a 20 per cent. superphosphate.

Nitrogen, 31 pounds, or 200 pounds of nitrate of soda.

FOR BEET ROOTS, CARROTS, CHICORY.

Soluble phosphoric acid, 54 pounds, or 270 pounds of a 20 per cent. superphosphate.

Nitrogen, 36 pounds, or 225 pounds of nitrate of soda.

FOR TURNIPS.

Soluble phosphoric acid, 45 pounds, or 225 pounds of a 20 per cent. superphosphate.

Nitrogen, 40 pounds, or 270 pounds of nitrate of soda.

As legumes possess special powers of gathering up nitrogen, so tubers and roots possess very great power of absorbing potash. Unless, therefore, the soil is unusually poor in potash, it will not be necessary to supply that constituent in their case.

FOR FRUIT TREES.

Soluble phosphoric acid, 1-5 pound, or 1 pound of a 20 per cent. superphosphate.

Potash, ½ pound, or 1 pound of a 50 per cent. chloride of potash.

Nitrogen, 1 pound of nitrate of soda.

Quantity for a full grown, well developed tree.

FOR CUCUMBERS, MELONS, SQUASHES, ASPARAGUS, STRAWBERRIES.

Soluble phosphoric acid, 45 pounds, or 220 pounds of a 20 per cent. superphosphate.

Potash, 67 pounds, or 135 pounds of a 50 per cent. chloride of potash.

Nitrogen, 27 pounds, or 180 pounds of sodium nitrate.

It should, of course, be borne in mind that these are *general* recommendations, to be changed to suit peculiar local conditions of soil and climate. The quantity of each constituent given is neither the highest nor lowest that may be used, but is intended to represent a medium application. If blood and bone, dried blood, cotton-seed meal or fish scrap are used as sources of nitrogen, instead of nitrate of soda, it should not be forgotten that they contain considerable potash and phosphoric acid, and that these two constituents of the formulas can be diminished correspondingly.

CONCLUSION.

How can the farmer best utilize the small deposits of phosphatic material that are found on his own farm or in his own neighborhood? To the small farmer that is the most vital of all the phosphate questions before the State. In order to answer it experiments of the following kind should be made:

I. To *test* the effect of composting muck, farm-yard manure, cotton-seed meal, etc., with finely pulverized phosphate rock, and "phosphate clay."

There is reason to expect that some of the phosphate would be converted into superphosphate and that it would be otherwise rendered more available as plant food.

II. To determine the relative manurial value of superphosphate, pulverized phosphatic rock, and composts such as are described under I, the tests to be made with various crops and on all kinds of soil.

That the superphosphate, pound for pound, is far more valuable for immediate production than the insoluble or tri-calcic phosphate has long ago been settled; but the former costs four times as much as the latter. Would, or would not, the same money laid out in the latter be in the long run the better investment? But more particularly in cases where the farmer has phosphate on his own farm, can he afford to pay out ready cash for the superphosphates of the large manufacturers?

III. To determine whether, or not, the farmer can economically manufacture his own superphosphate.

Considering the difficulties in the way, no one would hesitate to answer this question in the negative, but for the fact of the phosphatic deposits at the farmer's door and on his own land. This makes the question worth asking and attempting to solve.

COST OF SULPHURIC ACID.

The following are New York quotations for June 2, 1890:

Clear and most concentrated, 66° Baume; best brimstone acid:

Single ton, 1¼ cents per pound; 10 ton lots, 1 cent per pound; 50 ton lots, 1 cent less 1 per cent. per pound. Carboys cost $1.50 net.

(Note.—Carboys would doubtless be received back by the dealer in acid, the buyer paying return freight.) 66° Baume acid will contain only about 80 per cent. acid.

FREIGHT RATES ON SULPHURIC ACID, NEW YORK TO JACKSONVILLE, RELEASED, CLYDE LINE.

In carboys, boxed, 32 cents per 100 pounds.
In iron casks, 18 cents per pound.
Rate, quoted May 30, 1890.

PRICE OF S. C. PHOSPHATE ROCK IN CHARLESTON.

The following quotations per ton have obtained during the past winter and spring: "Alongside vessels, crude, $5.75; hot-air dried, $6.25; dried, $7.25; ground rock, $8.50."

TABLE I.

[ANALYSES MAINLY BY J. J. EARLE.]

The name and post office of the sender is given with each sample; where stated by the sender what county the deposit is located in, the the name of the county is given in brackets. It is not known to us what counties the others are from.

		Moisture.	Sand and insoluble matter.	Phosphoric Acid (P2O5).	Tricalcium Phosphate (calculated).
91	J. H. Ruff, Ft. White	....	57.30	13.20	28.81
92	" Ft. White	....	61.30	9.59	20.82
93	M. C. Withrow, Hernando	....	34.50	20.00	43.65
98	Eichelberg, Ocala	....	....	40.30	87.97
105	" "	5.20	3.30	35.00	76.40
106	" "	2.90	7.78	34.48	75.26
107	" "	4.35	15.32	29.80	65.05
108	" "	1.50	4.14	35.16	76.75
109	" "	1.84	2.40	35.40	77.27
110	" "	1.05	1.78	37.32	81.46
111	" "	2.53	8.57	33.68	73.52
112	" "	....	95.00	00.00	00.00
114	J. P. DePass, Lake City, [Levy county]	17.07	42.56	11.59	25.30
116	" " [Levy county]	0.45	82.42	6.04	13.18
124	J. E. Young, Lake City, [Columbia county]	3.30	58.24	11.96	26.15
125 (*a*)	J. E. Young " [Columbia county]	12.42	44.05	14.72	32.13
125 (*b*)	" " [Columbia county]	2.00	34.67	23.68	51.69
119	E. T. Paine, Jacksonville	1.23	13.38	32.92	71.86
120	Jno. T. Arnold, Sanford	5.75	40.99	17.40	37.98
121	" "	8.85	21.61	24.60	53.70
122	" "	3.50	32.17	20.52	44.79
123	" "	2.10	7.87	31.48	68.71
127	J. P. DePass, Lake City, [Levy county]	7.15	4.34	33.04	72.12
128	Jno. Thompson, New Waldo, [Alachua county]	0.70	11.13	2.56	5.58
129	W. W. Breese, Waldo	1.05	23.01	24.24	52.91
130	" "	4.65	76.98	2.80	6.11
131	W. M. Smith, Archer, [Levy county]	2.22	18.65	27.98	61.07
132	J. M. Jackson, Bronson, [Levy county]	1.25	32.96	11.00	24.00
133	" " "	5.90	71.43	7.68	16.76
144	T. V. Moore, Fruit Cove, [Polk county]	0.90	9.45	33.40	72.90
145	" " "	4.00	26.18	25.58	55.84
148	J. F. Miller, for Mrs. Eskridge, Mansfield, [Citrus county]	2.60	7.13	34.16	74.56
169	S. B. Thompson, Lake City, [Columbia county]	2.40	58.18	10.24	22.35
171	J. F. Baya, " "	2.75	46.41	17.52	38.24
172	C. L. Peek, Starke,	4.60	11.82	13.56	29.60
177	" " [Bradford county]	9.95	17.20	25.58	55.84
179	J. E. Young, Lake City, [Columbia county]	1.45	58.68	13.80	30.12
180	Dr. Smoke, Mikesville, "	26.90	34.57	14.44	31.52
181	" " "	24.55	39.25	12.52	27.33
182	L. W. Lipsey, Citra, [Marion county]	3.75	1.02	34.92	76.22
183	L. W. Lipsey, " [Marion county]	1.85	1.40	38.64	84.34
184	A. J. Camp, Campville	3.70	34.50	21.88	47.76
185	C. G. Adams, Sorrento	8.75	11.57	30.84	67.32
186	W. C. Barnard, Archer, [Levy county]	1.05	0.70	36.96	80.68
187	R. B. Hodgson, " [Levy county]	6.35	2.80	33.64	73.43
188	J. P. DePass, Lake City, [Levy county]	1.95	0.70	34.92	76.22
189	" " [Levy county]	2.55	2.25	37.00	80.76
190	H. B. Peacock, Luraville	6.20	62.23	0.76	1.61
191	C. L. Peek, Starke	1.40	88.35	2.56	5.58
192	Dr. J. C. Neal, Lake City, [Alachua county]	29.70	5.35	24.04	52.47
193	C. H. Robinson, Lenard	1.30	66.70	7.68	16.76
194	J. H. Coon, Lake City, [Columbia county]	2.96	63.90	9.72	21.22
195	L. F. Frink, "	3.50	2.62	35.81	78.19
200	Jas. P. DePass, " [Levy county]	1.70	.20	36.84	80.41
201	" " "	2.60	88.75	2.28	4.79
202	Mrs. Mosten, "	2.40	4.50	32.48	70.90
203	Murphy & Jackson, Manatee	1.65	0.45	33.24	72.56
204	" "	5.65	50.50	13.04	28.46
205	" "	2.58	5.78	2.04	4.45
207	J. A. Wills, Starke	4.10	38.58	5.78	12.57
208	J. A Wills, "	.78	22.07	1.52	3.32

TABLE I. (Continued.)

[ANALYSES MAINLY BY J. J. EARLE.]

The name and post office of the sender is given with each sample; where stated by the sender what county the deposit is located in, the name of the county is given in brackets. It is not known to us what counties the others are from.

		Moisture.	Sand and insoluble matter.	Phosphoric Acid (P_2O_5).	Tricalcium Phosphate (calculated).
209		1.80	7.85	34.00	74.22
210		1.50	3.42	34.79	75.95
211	F. W. Pope, Jacksonville	....	....	34.80	75.96
211 (a)	Josie McDonald, Archer, [Levy county]	3.55	2.15	33.88	73.95
212	F. S. McDonald, " "	2.15	2.50	34.28	74.83
213	Preston King, " "	3.30	5.10	33.52	73.17
214	Charlie McDonald, " "	1.45	0.05	38.36	83.73
215	J. S. White, Live Oak, [Hamilton county]	12.68	56.22	6.92	15.90
216	" " [Suwannee county]	4 80	6.40	33.16	72.38
217	W. G. Tousey, Seffner, [Hillsboro county]	2.30	38.02	19.44	42.43
218	W. E. Davis, Starke	2.30	30.38	21.88	47.76
219	Jim Perryman, Archer, [Levy county]	0.60	0.13	38.48	84.00
220	Anderson Mattair, " [Marion county]	1.00	0.22	38.36	83.73
221	J. N. Jones, Starke	1 95	9.75	32.36	70.20
222	W. Gwynn, Sanford	15.85	54.60	7.60	16.59
223	" "	19.59	32.45	16.40	35.80
224	J. H. Welsh, Welshton, [Marion county]	0.50	1.00	38.36	83.73
226	J. P. DePass, Lake City, [Levy county]	....	....	36.45	79.56
227	E. T. Paine, Jacksonville	....	45.05	15.86	34.62
228	Dr. J. C. Neal, [Alachua county]	2.62	55.70	15 35	33.50
229	Jno. F. Rollins, Jacksonville	2.00	23.50	31.34	68.41
230	" "	7.45	25.37	24.00	52.40
231	J. E. Young, Lake City, [Columbia county]	1 85	39.30	22.76	49.70
232	J. P. DePass, "	6.00	28.70	20.72	45.23
233		6.50	32.40	16.37	35.74
234	G. F. McDonald, Lake City, [Levy county]	0.95	0.10	39.52	86.26
235	" "	2 75	3.90	35.32	77.07
236	W. J. McDonald, Archer, [Levy county]	4.45	13.05	32.87	71.76
237	" " "	2.79	11.55	33.51	73.38
238	C. W. McDonald, " "	1.95	1.50	36.32	79.30
241	J. S. McFall, Wildwood, [Marion county]	2.71	34.39	18.57	40.53
242	A. J. Russell, Tallahassee, [Wakulla county]	3.33	31.96	19.44	42.43
243	......Emmons, Lake City, "	2.25	63.57	2.06	4.49
244	Ellis & Hardgrave, Citra, [Levy county]	0.86	2.79	36.63	79.96

TABLE II.

Contents of Iron and Aluminium in some Florida Phosphates. [ANALYSES BY J. J. EARLE.]	123	125(b)	98	107	148	177	183	193	203
Moisture	1.66	2.58	2.65	4.95	2.30	10.78	2.36	1.55	1.88
Organic and volatile matter	2.62	4.00	1.82	4.00	3.53	2.80	2.70	10 15	4.18
Sand and insoluble matter	6.50	34.67	0.38	13.30	5.78	16.35	1.04	62.75	0.35
Ferric oxide	0.02	....	0 48	....	0.80	....	0.40	....	....
Alumina	2.60	8.60	2 96	6 00	8.61	4.60	5.12	13.40	....
Lime	45.92	24.60	49.80	38.40	39.40	36.48	46.40	3.20	51.20
Phosphoric acid	33.90	23.68	39.60	30.70	35.56	26.88	38.63	8.57	35.82
Carbonic acid	3.20	0.89	1 50	2.03	1.58	2 95	2.42	....	5.00
Fluorine and undetermined	3.58	0.98	0.71	0.63	2.45	....	0.93	0.38	1.57

TABLE III.

(Calculated from Table II.)

	123	125(b)	98	107	148	177	183	193	203
Moisture	1.66	2.58	2.65	4.95	2.30	10.78	2.36	1.55	1.88
Organic and volatile matter	2.62	4.00	1 82	4.00	3.53	2.80	2.70	10.15	4 18
Sand and insoluble matter	6.50	34.67	0.38	13.30	5.78	16.35	1.04	62.75	0.35
Ferric oxide	0.02	....	0.48	....	0.80	....	0.40	....	....
Alumina	2.60	5.84	2.97	6.00	5.97	4.60	3.67	9.14	....
Calcium carbonate	7.27	2.02	3.41	4.61	3.58	6.70	5.50	....	11.36
Tricalcium phosphate	74.00	43.30	86.44	67.01	69.30	58.68	79 92	5.90	78.18
Aluminium phosphate	....	6.60	....	....	6.28	....	3.46	10.13	....

TABLE IV.

[ANALYSES BY J. J. EARLE.]

Superphosphates made by treating 12 parts by weight of Florida rock with 9 parts by weight of sulphuric acid, of 1.5 specific gravity (about 60 per cent. acid). The rock was powdered so as all to pass through a sieve of forty meshes to the linear inch.

No. of Sample.	Condition and Appearance of Powdered Rock immediately after Treating it with Acid.	Condition 50 Days After Treatment.	Rock.				Superphosphate.		
			Water.	Sand and Insoluble Matter.	Phosphoric Acid.	Equivalent of Phosphoric Acid in Bone Phosphate	Water.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.
107	Becomes barely moist	Dry and crumbly	4.95	15.32	29.80	65.05	8.80	14.72	2.93
123	Becomes a thin mush containing clumps	Dry and very hard.	2.10	7.87	31.78	68.71	5.14	19.06	1.14
148	Becomes a very stiff mush	Dry and very hard.	2.60	7.13	34.16	74.56	7.47	17.52	1.80
183	Becomes barely moist	Dry and very hard.	1.85	1.40	38.64	84.36	5.00	18.16	4.62
185	Becomes barely moist	Dry and very hard.	8.75	11.57	30.84	67.32	2.43	19.50	1.16
187	Becomes a stiff mush	Dry and very hard.	6.35	2.80	33.64	73.43	8.02	19.06	0.77
193	Becomes tough, like dough	Dry, hard and tough	1.30	66.70	7.68	16.76	7.25	5.50	0.01
203	Becomes a stiff mush, with clumps in it	Dry and very hard.	1.65	0.45	33.24	72.56	6.28	18.42	0.00
	South Carolina and other rock similarly treated:*								
...	South Carolina	....	....	......	......	......	....	9½ to 15½	....
...	Cambridge Coprolites	....	....	5.91	26.47	57.78	....	10	....
...	French Coprolites	....	....	27.78	20.71	45.25	....	7½	....
...	Bordeaux Phosphate	....	....	14.58 1.29	21.46 to 32.03	46.85 69.92	....	5 to 15	....
...	German Phosphate	....	....	35.89 4.95	17.56 34.88	38.33 76.14	....	8 to 16	....
...	Spanish Phosphate	....	....	52.50 12.63	20.15 36.97	43.99 80.71	....	9 to 20	....
...	Rio Grande Bone Ash	....	....	......	39.84	86.97	....	14	....

*From Report of South Carolina Commissioner of Agriculture, 1880.

TABLE V.

No. of Sample.	SPECIFIC GRAVITIES. [BY J. M. PICKELL.] Sampies Taken at Random.	Specific Gravity.	Content of Phosphate.	Content of Solid and Insoluble Matter.	Content of Moisture.
171	Color, grayish white; coarse grained, friable	1.835	38.24	46.41	2.75
195	Color, light cream; irregular texture, containing crevices and holes, friable	2.196	78.19	2.62	3.50
110	Color, deeper cream; irregular texture, containing crevices and holes, friable	2.532	81.46	1.78	1.05
108	Color, deeper cream; irregular texture, containing crevices and holes, friable	2.640	73.52	8.57	2.55
144	Color, deep cream; fine grained, soft, easily scratched with finger nail	2.644	72.90	9.45	0.90
185	Color, light cream; fine grained, soft, easily scratched with finger nail	2.660	67.32	11.57	8.75
148	Color, deep cream; texture similar to 195	2.780	74.56	7.13	2.60
111	Color. light cream; texture similar to 195	2.786	73.52	8.57	2.55
119	Color, light cream; texture similar to 185	2.807	71.86	13.38	1.23
123	Color, brownish; hard, flint-like, conchoidal fracture	2.911	68.71	7.87	2.10
182	Color, cream; comparatively soft, conchoidal fracture	2.959	76.22	1.02	3.75
109	Color, yellow; texture similar to 123	2.971	77.27	7.40	1.84
	Average specific gravity.	2.643			

Some of these samples are hard enough to scratch common window glass, others are so soft as to be scratched with the finger nail; 185, in particular, leaving a white mark, like chalk, when drawn across a board.

BULLETIN No. 11,

OF THE

EXPERIMENT STATION

OF FLORIDA,

AT THE

STATE AGRICULTURAL COLLEGE.

Lake City, Florida.

OCTOBER, 1890.

EXPERIMENTS IN CORN AND IRISH POTATOES AND ANALYSIS OF GRASSES, ETC.

REV. JAS. P. DEPASS, DIRECTOR.

STAFF:

DR. J. C. NEAL, ENTOMOLOGIST AND BOTANIST.
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J. J. EARLE, A. B., ASSISTANT CHEMIST.

JACKSONVILLE, FLORIDA:
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NOTICE.

The laboratory of the Station will be worked to its utmost capacity for several months in a special line of investigation, and hence all applications for analyses will be declined.

JAS. P. DEPASS,
Director.

GENERAL POLICY.

The policy in part I have laid down to follow is:

1. To find out the best and cheapest manures for all agricultural products.
2. The best and cheapest methods of cultivation.
3. The tools which do the best work and are best adapted to our soil and crops.

In regard to the two first, I have given some opinions in reporting crops. In reference to the third, I have also made some reports. It may be well to state farther for the information of our farmers, that the one-horse Planet Jr. cultivator is a most complete tool, and ought to be on every farm. It does its work well, is easily handled and saves labor. This cultivator will do the best kind of work in a grove or orchard. It is adapted to rough and smooth land, and to land with or without stumps. The Chattanooga Plow Works gives us in the New South the best turn plow I have used. This firm manufactures also cheap and most excellent cane mills. I have just had tested one of their portable furnaces and self-skimming evaporators for making syrup. It is light, easily managed and does good and rapid work. Mr. J. W. Butler, a practical syrup and sugar maker, gave an exhibition of this furnace and evaporator on the station on the 3d of November, which was a demonstration of its superior advantages in syrup making, for cleanliness and for uniform quality of syrup. Juice was kept flowing in the pan at one end constantly, by means of a faucet in a barrel elevated above the pan, and in twenty-three minutes Mr. Butler had syrup running out the other end, which was kept up until the day faded into night.

Clark's two-horse cutaway harrow is a most excellent tool, and for pulverizing rough and cloddy land and for covering small seed after the land is broken up is without an equal. In preparing a piece of land this fall for rye, which had grown up in large weeds and grass, I run this harrow both ways over the field, and it not only broke them down, but to a large extent cut them up, thus making it easy work for a one-horse turn plow to turn under weeds and grass thoroughly.

CORN EXPERIMENT.

The main idea in the corn experiment this year was in selecting a plot of land that would represent as near as possible the average land of the State. Without a practical knowledge of the producing qualities of the plots selected last year, results proved that the quality of land was above the average; one plot bringing 19½ bushels per acre and the other 13 bushels without fertilizer. The yield last year in excess of the natural land, as may be seen in Bulletin 7, under very heavy fertilization was too small to warrant the opinion that excessive and costly fertilization of corn would be profitable. Nor am I prepared from this year's experience to venture the opinion that the intensive system will become, or ought to be the rule of the farmer in regard to this crop. Seasons and climatic causes largely modify the yield, and these are so variable in our State as to prevent any definite average as to annual production. It has become a settled conviction among farmers that our climate is not adapted to the profitable production of corn as a marketable crop. While the yield has doubtless had much to do with this opinion, the true cause may most likely be attributed to the soil. The following analysis in Bulletin 2, of the station soil, five inches deep, taken from a part of the farm that has been cleared the longest, and which has been in cultivation over thirty years, gives an idea of its productive forces: Water, 0.51 per cent.; organic and volatile matter, 1.27; sand, 96.02; clay, 2.77; oxides of iron and aluminum, 0.33; lime, 0.06; magnesia, 0.03; phosphoric acid, 0.07; potash and soda, 0.09. This land was originally high hammock, bordering a large lake. This one in Bulletin 5 is taken from the virgin soil in low hammock, about one hundred yards from the lake, the same depth: Moisture at 100 degrees, 0.59 per cent.; organic and volatile matter, 2.50; lime, 0.03; magnesia, 0.02; phosphoric acid, 0.02; potash and soda, 0.10; iron and aluminum oxides, 0.13; clay, 0.50; sand, 96.00. These two samples give some idea of the available land upon the station.

Now, if these are compared with the analysis of land planted in corn adjacent to Missouri Experimental Station, on which a most elaborate and scientific experiment last year was made, it will be seen that the Missouri soil is far better adapted to the growth of corn than that used by me. It is as follows: Analysis, 1, a.: Water at 100 degrees, 1.82 per cent.; nitrogen, total, 0 14; carbon, total, 1.63; loss by ignition, 6.97; silica, 77.82; aluminum, 8.93; oxide of iron, 3.05; lime, 0.63; magnesia, 0.64; potash, 1.32; soda, 1.59; phosphoric acid, 0.08. The increase does not warrant the use of fertilizers on this soil. In Florida the question as to whether it is profitable to plant corn has been settled by the universal practice of our farmers who plant the standard crop in trying to make enough for home demands. It would be a sad day, indeed, if they were to reach the conclusion that it would be better to buy their grain instead of raising it, until the products of our State in the farming sections change, as they have done so largely in East and South Florida. And it is becoming a very important question with some, in the Eastern and Southern portions of our State where vegetables and fruits are the leading products, if the planting of corn, at least to a limited extent, would not be better than to neglect it altogether, when the prices paid for Western corn ranges from 60 cents to $1.00 per bushel, and forage from $20.00 and upwards per ton, to say nothing of the labor and time in hauling it.

The land selected was as poor as I thought could be found on the station, except some which was almost entirely sterilized by various causes unnecessary to mention here. The rows were five feet apart and the corn on the unfertilized plot averaged three feet in the drill, the fertilized about eighteen inches. The stand on each plot was a complete one.

The stand in the fertilized plots was too crowded and, as a result, some stalks failed to ear while some others did not bear as heavy ears as they otherwise would have done.

The fodder was not pulled and the corn was fully matured.

The land was prepared by bedding with the New South. The water furrow was fertilized March 14th, and covered with two furrows by a four inch bull-tongue. On March 24th the furrows were opened with a bull-tongue and the seed planted and covered with two furrows by the same plow.

When the plants began to break the ground and some were up as high as one or two inches, a straight-toothed harrow was run across the plots, leaving them level. The use of the harrow at this time is twofold. First, it breaks the crust, ensuring a good stand; and, second, it serves as a working by killing the young grass and the germs of grass seed just beginning to sprout.

The corn was worked by the Planet Jr. cultivator on April 11th, 25th and May 13th. When laid by it was about four feet high or when it was bunching to tassel.

The unfertilized plot yielded 7¾ bushels.

Plot No. 2 was fertilized with Pot-Ammoniac, manufactured by the Cotton Ginning Company, Madison, Fla. Its cost, delivered, was $27.50 per ton. One thousand pounds was placed on an acre and the yield was 20¾ bushels. The excess costing per bushel in round figures $1.05.

No. 3.—One thousand pounds of Blood and Bone was used at a cost of $36.50 per ton. The yield was 24⅓ bushels. Cost per bushel of excess was $1.11.

No. 4.—This experiment was made with a compost made on the farm, the formula of which is given below, at the rate of one ton per acre. Outside the stable manure the cost of materials in one ton was $6.66. The yield was 27⅓ bushels. Cost per bushel of excess was in a fraction of 35 cents.

No. 5 was made with one thousand pounds black cotton-seed meal manufactured by the Cotton Ginning Company, of Madison, Fla. Its cost per ton, with freight, was $22.50. The yield was 32½ bushels. The cost per bushel of excess was nearly 46 cents.

In giving the value per bushel of the excess the fractional part of a cent is not stated.

The Pot-Ammoniac and Blood and Bone experiments will be dropped out the next season for the reasons that they are too costly and are not adapted to corn. For the same reason we dropped out this year several fertilizers used the last.

It will be seen, by comparing the experiment with cotton-seed meal with last year's, that the same amount of corn per acre was made this year on much poorer land with one thousand pounds as was made with one ton the past year. The cause of this may be that last year there was not enough rain to dissolve the manure, the season being very dry in the growing and making period, while this year there were good rains.

The above fact suggests that too much fertilizer may be used and as good results with a less quantity may be obtained. The land so heavily fertilized the past year with crushed cotton-seed and cotton-seed meal was planted again this year without fertilizing. The yield was less than land that had never been fertilized in the same field.

The experiments the past year was in favor of cottonseed meal. This year the compost makes the cheapest corn and the cottonseed meal the next.

IRISH POTATO EXPERIMENT.

The object of this experiment was a test of the various kinds of seed sold in Jacksonville, in order to find the best adapted to our soil and climate. Accordingly I bought seed of every variety offered on the market the middle of January.

The land was prepared by bedding out the rows three and one-half feet wide. The fertilizer used was the compost as given on another page. The amount per acre was 2,000 pounds, or thirty-six pounds to the row, allowing seventy yards square to the acre. The fertilizer was evenly distributed in rows by hand, and mixed by running a straight shovel or bull tongue in the row.

The seed was cut thin with one and two eyes and dropped one foot apart in drill on January 30, and covered with two furrows by a New South. They were plowed March 20, and plowed and hoed April 12.

The March freeze cut them back to the ground, but they soon rallied, making a good stand. The seasons were very favorable. The soil was light and sandy, high and dry, and of medium quality. The plot selected had been cultivated for years in vegetables and field crops.

The potatoes were well matured and of good size, having but a very small percentage of culls.

The earliest was the Chili Red, and next The Beauty of Hebron. The Chili Red began to mature about April 10th, and The Beauty of Hebron the 20th. The Scotch Magnum was the latest, maturing about the 15th of May, and the Burbank a week earlier.

The following eight varieties were planted: Jackson White, Eastern Fancy Rose, Chili Red, The Early Beauty of Hebron, Peerless, Russetts, Burbank and Scotch Magnum.

The Scotch Magnum yielded 104¼ bushels per acre.

The Burbank, 160⅓ bushels.

The Russetts, 74¾ bushels.

Peerless, 110⅓ bushels.

Early Beauty of Hebron, 104 bushels.

Chili Red, 74¾ bushels.

Eastern Fancy Rose, 52 bushels.

Jackson White, 22¾ bushels.

They were all white except the Scotch Magnum and Early Beauty of Hebron, which are pink eyed.

It will be observed that the largest yield was made by the Burbank.

There was no experiment made in unfertilized land. Experience has demonstrated that Florida soil will not produce the potato unless well fertilized, except in fresh hammock. When planted in hammock the yield is not large comparatively, and then it is liable to injury from worms and fungus growths, which causes it to rot sometimes before maturity or soon after being dug. Even in rich garden spots or cow-pens on pine land, when there is much vegetable matter in the soil, the rot assails the potato and renders it almost worthless.

The above crop was free from any disease or enemy, and seed potatoes were saved for fall planting.

The potato after being dug, if housed in a dry dark room or under the house where it is dry, and spread out, not being allowed to bulk, will keep bright through the summer and fall. If housed where the light is not excluded, they become watery and the skin greenish, rendering them unfit to eat.

The Irish potato as a paying crop is rather doubtful in Northern Florida, unless it can be made in larger quantities than the above experiments indicate, and unless it can be marketed earlier than other sections more favorable to its production. The Chili Red and Beauty of Hebron, if they can be produced in sufficient quantity and without too much cost as to fertilizers and transportation, give some promise in this direction.

If in South Florida, where fall and winter plantings can be made without the fear of damaging frosts, and where they can be matured early in the spring, if they can be produced in sufficient quantity and shipped in car-load lots, which is cheaper, it is possible that this section of the State may have a monopoly of the early market.

For the benefit of those who are interested in this crop, both for market and home consumption, I quote largely from Bulletin 4, Second Series of the Louisiana Experimental Station, an elaborate and extensive experiment on two stations:

First, on Sugar Experiment Station, No. 1, Audubon Park, New Orleans, ten varieties, usually sold for seed in New Orleans, were fertilized with cottonseed meal and acid phosphate at the rate of 500 pounds per acre. The yield in merchantable potatoes was from 74.4 to 136.6 barrels.

On the North Louisiana Experiment Station fifty-seven varieties were planted. In regard to soil it says:

"The soil was a loose gray sand, very poor. Previous culture, ensilage corn Broken with two horses. Rows laid off three feet apart, with straight shovel, into these furrows the fertilizer was evenly distributed by hand and covered with two furrows of turn plow. This was opened again with straight shovel and into this furrow, pieces of potatoes, cut to three or four eyes, weredropped, twelve inches apart and covered with a turn plow. The fertilizer used was 700 pounds per acre, of a mixture consisting of 400 pounds cottonseed meal, 200 pounds acid phosphate and 100 pounds kainit. The seasons were very propitious. It received one cultivation with hoe and plow."

The conclusions as to yield were:

"Six of the above varieties yielded over four hundred bushels per acre, viz.: Boston Peerless, Vermont Early Rose, Beauty of Hebron, Cayuga, Callun's Superb, and Russet. Eleven gave over three hundred and fifty bushels, viz.: Parson's Prolific, Enos Seedling, Home Comfort, Late Favorite, Webb's Early, Sylvian, Extra Early Vermont, Dunn's Seed, Early Puritan, Dictator, Platt's No. 5. Thirteen followed with yields over three hundred bushels per acre, viz.: Baker's Imperial, Strawberry, Bliss' Triumph, Burbank, Sunset, Great Eastern, English Kidney, Rural Blush, Irish Cup, Scotch B., Dunnmore, James Vick, and Buffalo Beauty. Of the remainder, seven gave less than two hundred bushels per acre.

"The lowest yield was 170 bushels per acre, while the highest 435."

In reference to size of seed it says:

"Shall we plant the whole potato or cuttings, and what size of each are most productive and economical? Seven varieties of potatoes were used, each being treated exactly alike.

"In each row there were planted eight large potatoes, [a]; eight medium potatoes, [b]; eight pieces, cut, two or more eyes, [c]; and eight pieces cut to one eye, [d]; weighed and planted one foot apart.

"Below is a table giving weight of potatoes and cuttings planted; [a], weight of eight large potatoes; [b], weight of eight medium potatoes; [c], weight of eight cuttings, two or more eyes, and [d] weight of eight cuttings, one eye.

NAME OF VARIETY USED.	Weight of 8 large potatoes planted. "A"	Weight of 8 medium potatoes planted. "B"	Weight of 8 cuttings, 2 or more eyes planted. "C"	Weight of 8 cuttings, one eye planted. "D"
Early Rose	3 lbs	1 1-4 lbs	7-16 lb	1-6 lb
Boston Peerless	4 lbs	1 5-8 lbs	5-8 lb	1-8 lb
Beauty of Hebron	2 11-16 lbs	1 lb	7-16 lb	1-4 lb
Rural Blush	3 lbs	1 1 4 lbs	7-16 lb	3-16 lb
Extra Early Vermont	2 7-24 lbs	1 lb	5-8 lb	1-8 lb
Russett	2 7-16 lbs	7-16 lbs	1-2 lb	1-8 lb
Burbank	1 5-16 lbs	1 lb	3-16 lb	1-8 lb

In regard to the yeld:

"The productive results obtained concur with those of previous years; the larger the seed planted the greater the yield. The economical results are, however, different. To determine these an account must be taken of seed planted and the net yield per acre determined. To make this plain, a table is given showing amounts planted per acre with each experiment and variety, together with the net yield. In this calculation a farmer's acre seventy yards square is assumed for convenience. The rows were three feet apart and the potatoes dropped one foot apart. This gives 14,560 hills per acre.

"The following will give a concise statement of results:

VARIETY.	"A," Bushels per acre.		"B," Bushels per acre.		"C," Bushels per acre.		"D," Bushels per acre.	
	Planted.	Net Yield.	Planted.	Net Yield.	Planted.	Net Yield.	Planted.	Net Yield.
Early Rose	97½	278½	41	265	14	248	5½	254½
Boston Peerless	130	263	45	266	20	335	4	209
Beauty of Hebron	87	218	32½	255½	14	254	8	203
Rural Blush	97½	276½	41	192	14	155	12	147
Extra Early Vermont	74½	134½	33½	144½	20	183	4	173
Russet	80	198	14	260	16	242	4	158
Burbank	43	211	32½	160½	6	207	4	121
Average	87	225½	34½	220½	15	225	6	181

"From the above it would seem that while the total production is in direct proportion to the size of potato planted, the net yield, after deducting seed planted, varies but little. It is doubtful whether on a large scale pieces of potatoes larger than four eyes or smaller than two eyes, will be found of the most profitable use as seed."

Twenty experiments with different kinds and quality of fertilizers were made, among which acid phosphate and cottonseed meal gave the best results. Kainit, it states, does not appear to be adapted to this crop. It says also that—

"The mineral forms of nitrogen did not accomplish results expected. They were doubtless washed from the soil by the very heavy rains of early spring before the plant could assimilate them, and again suggest caution in the use of these forms upon sandy soils in this climate.

"Cotton seed, either whole, crushed or composted, and cottonseed meal are most excellent forms of nitrogen for this plant, and when combined properly with acid phosphate gives the best fertilizers for Irish potatoes."

The following deductions from experiments are given to our readers which may be of value to them:

"First: Select for planting varieties known to be adapted to soil and climate.

"Second: Western-raised potatoes are as good for seed as those raised in the East, and are usually cheaper.

"Third: There is no necessity of buying seed from either, as home-grown seed are equal if not superior to any.

"Fourth: Cotton seed, or cottonseed meal, mixed with a high grade acid phosphate, furnishes an excellent and cheap fertilizer for potatoes, and should be used liberally.

"Fifth: That cuttings containing from two to four eyes are perhaps the best size of the seed, when planted on a large scale.

"Sixth: That any early potato crop when properly harvested and shipped can be made very profitable."

I note that the unfertilized land brought from 56 to 75.6 bushels of merchantable potatoes, and with culls from 71.4 to 92.1 bushels.

With 1512 lbs. cottonseed meal and 420 lbs acid phosphate, the largest yield was made 372.5 bushels, including 50 bushels of culls.

FERTILIZERS.

The fertilizers used mainly on the farm this year were Blood and Bone, Ground Bone, Pot Ammoniac, Black Cotton Seed Meal, Paine & Son's Orange Food and Cane Fertilizer, Acid Phosphate, Copperas, and a compost made on the farm.

The formula for compost is: 2000 lbs. stable manure and 333 lbs. each of cottonseed meal, kainit and acid phosphate placed in covered pen, in the order named, the above constituting one layer and wet thoroughly this repeated until pen is full, when the top is covered with dry dirt and left from two to three months, when it is ready for use. The compost is prepared for distribution by taking out one side of pen and cutting from the top down and mixing well with hoe, being careful to break all lumps.

This compost was used on every crop, except with cane, giving very gratifying results. I have modified its proportions for the next year, adding other materials for the purpose of improving it, while I have also retained the above formula for use.

My object is to produce a fertilizer that is within the reach of every farmer in the State, if a little industry and care is used, that is cheap, and that will produce results with those, the cost of which are beyond the man of moderate means. The above formula is made upon the station at a cost of $6 66 for materials, outside of labor and the stable manure. Two men can take manure out of stable, weigh it, and with the other ingredients pen from eight to eleven tons a day. A basket or barrel is filled with stable manure and weighed. After weighing several barrels an average can be obtained, when the work may proceed without further delay. The same course is pursued with the other materials.

I selected four rows of orange trees and used 25 lbs. of this compost on one row, 15 lbs. ground bone on the second, 15 lbs. of Paine & Son's Orange Food on the third, 15 lbs. of acid phosphate on the fourth. The acid phosphate alone, while it produced some results, was not as good as either of the other three.

The other three produced a fine growth and but little, if any, difference would be observed between them.

On vegetables, such as cabbage, beets, onions, beans, lettuce, okra, squashes and melons, both water and musk, I used the compost in comparison with cottonseed meal, and the results were very much in favor of the compost. It is noticable that in the use of cottonseed meal and crushed cotton seed no benefit to a second crop is observed, while the above compost improves the lands. Some advantage is perceptable the second year with rotted bone and gossypium, but not to that extent where the compost is used.

The compost used on peach and pear trees is a most excellent fertilizer, and the addition of one pound of sulphate of iron, which is copperas, is manifest.

Thus far cottonseed meal and the compost give the best results for a greater variety of crops over others used.

ANALYSIS OF SOME FLORIDA WEEDS AND GRASSES.

I. The Value to be Attached to Chemical Analysis of Feeding Stuffs.
II. Meaning of the Terms Used in the Analysis of Feeding Stuffs.
III. Some Florida Weeds and Grasses as Feeding Stuffs.

J. M. PICKELL.

In Table I (end of Bulletin) are given the analysis of a few grasses and weeds common in Florida.

I. THE VALUE TO BE ATTACHED TO CHEMICAL ANALYSIS OF FEEDING STUFFS.

The animal organism, notwithstanding its great complexity, is composed of comparatively few substances. These few substances can be reduced to still fewer classes. All animal matter is either combustible or incombustible (ash). The combustible part is either *nitrogenous* (containing nitrogen) or *non-nitrogenous* (not containing nitrogen). The non nitrogenous part consists of fat, oil, tallow, etc. The muscles, tendons, nerves, etc., are made up of nitrogenous substances. These various substances find their way into the animal organism through the food. This is equivalent to saying through plants. All animals live either directly or indirectly on vegetable matter. Hence, we would expect to find close resemblance in the composition of animal and vegetable substances. This resemblance (almost identity) exists. The ash of plants contains every substance found in the ash of animals. The combustible part of plants contains either identically the same compounds found in the combustible part of animals, or else the compounds from which the latter are built up. Chemical analysis alone cannot tell whether a plant is fit for food, but, if fit for food, it can tell how much of the various crude food constituents it contains. What gives value to a feeding stuff, however, is not *how much* of the crude food constituents it contains, but how much of those constituents is *digestible*. Digestibility can be ascertained only by experiments on animals.* (It should be stated that there are artificial or laboratory methods of testing digestibility, and that they give results closely coinciding with those obtained by actual experiments on animals.) Chemical analysis, therefore, unaccompanied by digestion experiments, is merely suggestive of what may be the value of a feeding stuff.

II. MEANING OF TERMS USED IN THE ANALYSIS OF PLANTS.

PROTEIN.—This term is used to designate all nitrogenous substances in a feeding-stuff. The greater part of these consists of albuminoids, of which there is a large number. Albumin (the white of an egg), fibrin (lean meat), and casein (the basis of cheese) will serve as examples. They are all quite similar in composition. All, whether of vegetable or animal source, consist of nitrogen, carbon, hydrogen, oxygen and sulphur, in about the following proportions :

Carbon	52 to 54 per cent.
Hydrogen	7 per cent.
Nitrogen	15 to 17 per cent.
Oxygen	21 to 24 per cent.
Sulphur	1 to 1.5 per cent.

As previously stated, the muscles, tendons, nerves and the blood (largely)—in a word, that part of the organism subject to the greatest wear and tear and waste is made up of albuminoids. Albuminoids are, therefore, the most important part of feeding stuff; they are also the least abundant and most costly. A plant which furnishes them in greatest quantity is, other things being equal, the most valuable. As a rule, the albuminoids are most abundant in young, tender and growing plants. As the plant becomes mature they accumulate in the seeds. Hence it is that grasses whose seeds are so small as to be largely lost in harvesting, or else so small as to escape mastication and to pass through the system undigested, should be cut while young, before the albuminoids have gone into the seeds.

FIBER.—This is the most abundant of the non-nitrogenous constituents of plant food. The framework of plants consists of cells, sacks or tubes, the walls of which are cellulose or wood fiber. Examples of almost pure cellulose are cotton, flax, unsized paper. Cellulose is noted for its slight solubility—neither water, weak acids or alkalies dissolve it. By the action of strong sulphuric acid (vitriol) it is converted into grape sugar. Cellulose is not, as was formerly supposed, indigestible. But the digestibility decreases the older and more woody a plant is. As much as 30 to 70 per cent. of that contained in most of the common fodders is digestible.

NITROGEN-FREE EXTRACT.—Under this head are included starch, sugar (cane, fruit and milk sugar) and gums. Starch is identical in composition with cellulose, and it is second to it in quantity in the vegetable kingdom. If boiled with dilute acid it is converted into grape sugar.

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*Experiments of this kind require complicated and costly apparatus, as well as much time and a great amount of most painstaking observation and work ; and few, if any, have been made, or are being made, in this country. All that is known on the subject is due mainly to German scientists.

CRUDE FAT.—If dry vegetable substances are washed with ether, the ether will extract therefrom the vegetable oils and fats, and also small quantities of waxlike substances and coloring matter. These oils, fats, waxlike substances and coloring matter are not easily (if at all) separable from one another, and are all included under the term "crude fat."

Fiber or cellulose, starch, sugar, gums and fat are all composed of hydrogen, oxygen and carbon, and are known collectively as carbohydrates. Just as the albuminoids are the muscle producers, so these non-nitrogenous substances are heat-producers. Their consumption supplies the animal body with warmth.

The digestible fiber, starch, sugar, gums are all regarded of equal value as heat producers. The digestible fat, on the other hand, is regarded as having 2½ times the heat producing capacity of the foregoing pound for pound. Digestible fat, therefore, is 2½ times as valuable, pound for pound, as the other heat-producers.

NUTRITIVE RATIO.—The quantity of digestible albuminoids in a feeding-stuff as compared with the quantity of digestible heat-producers is known as the nutritive ratio. Average meadow hay has the following composition:

Water	14.3	per cent.	
Ash	6.2	"	
Protein	9.7	"	; digestible 5.4, or 56 per cent. of the whole.
Crude fibre	26.3	"	; " 15.0, or 57 " " "
Nitrogen-free extract	41.0	"	; " 25 8, or 63 " " "
Crude fat	2.5	"	; " 1.2, or 48 " " "

Multiply the digestible fat by 2½, and we get 3. Now add 3, the digestible fiber 15, and the digestible nitrogen-free extract 25.8, and we get 43.8. The nutritive ratio of average meadow hay is, therefore, as 5.4 to 43.8, or as 1 to 8.1.

The following is the nutritive ratio of some common feeding stuffs:

Potatoes	1 to 12	Wheat bran	1 to 4
Turnips	1 " 8	Corn meal	1 " 10
Oats	1 " 6	Cottonseed meal	1 " 1½
Maize	1 " 9	Wheat straw	1 " 69
Cow peas	1 " 3	Oat straw	1 " 28
Brewer's grain (dry)	1 " 3½	Pea straw	1 " 4

The meaning of this is that potatoes contain 12 times, cow peas 3 times, wheat straw 69 times as much heat-producing as muscle producing substance. Cow peas have a narrow nutritive ratio, that is are rich in protein. The reverse is true of potatoes and wheat straw, which have a wide nutritive ratio.

It is manifest that an animal should be supplied daily with food in such quantity, and containing the heat-producers and muscle-producers in such proportions as to compensate for the daily wear, tear and drain upon its system. And if the feeding is to be economical, it should be so conducted that there be no unnecessary consumption of the various food constituents. If. for example, it be found that a given animal needs 1.50 pounds of albuminoids, 9.5 pounds of nitrogen-free extract and fiber, and 0.4 pounds of fat per day, it would manifestly be wasteful to mix its food in such a way that it would get 2 pounds of albuminoids per day. A food so proportioned as to meet exactly the requirements of the animal is called a ration. It is evident that the ration will vary according to the size of the animal, according to whether it is at rest or work, according to whether it is young and growing or is full grown, fattening or not fattening, milking or not milking, wool-producing or not wool producing. The observant stock-feeder has been quick to note these different requirements.

A goodly number of scientific experiments have been made with a view to fixing Feeding Standards.

Thus it has been found that for 1,000 pounds of live weight animals need the following quantity of food and proportions of the different nutrients per day:

NUMBER OF POUNDS OF DRY MATTER, AND OF EACH NUTRIENT NEEDED PER DAY BY EACH 1,000 POUNDS OF LIVE WEIGHT:

	Pounds of total organic substance (dry).	Pounds of Albuminoids.	Pounds of Nitrogen-free extract.	Pounds of fat.	Pounds of total nutritive substance.	Nutritive ratio.
Horse at light work	21.00	1.50	9.50	0.40	11.40	1 to 7.0
Horse at heavy work	25 50	2.80	13.40	0.80	17.00	1 " 5.5
Oxen at rest in stall	17.50	0.70	8.00	0.15	8.85	1 " 12.0
Oxen at heavy work	26.00	2.40	13.20	0.50	16.10	1 " 6.0
Oxen fattening, 1st period	27 00	2.50	15.00	0.50	18.00	1 " 6.5
" " 2d "	26 00	3 00	14.80	0.70	18 50	1 " 5.5
" " 3d "	25.00	2.70	14.80	0.60	18 10	1 " 6.0
Milk cows	24.00	2.5	12.5	0.40	15.40	1 " 5 4

This list might be indefinitely extended, but it is sufficient to show that the teachings of science agree with the everyday experience, that the food of an animal must be adjusted to the kind of life the animal leads. Thus an ox at hard work requires not only *more* food than when at rest, but also a differently compounded food. Whereas 17½ pounds per day of a food containing 1 pound of digestible albuminoids to 12 pounds of digestible heat-producers are sufficient when at rest, at hard work 26 pounds of a food in which the proportion of albuminoids is twice as great (1 to 6) is necessary.

A glance over table No. 1 (see end of Bulletin) will show that cottonseed meal, cow peas, wheat bran and cow pea vines are to be classed in the order named among the feeding stuffs especially rich in albuminoids; oats, clover hay, Indian corn among the moderately rich. Indian corn, it will be noted, is much less concentrated than oats, contains, that is, much more starch and much less albuminoids. A feeding stuff rich in albuminoids should be fed in connection with coarse fodders, such as are rich in fiber, starch, etc.; cottonseed meal, for example, with a small amount of corn meal and with considerable amount of hay, corn fodder, etc.

It was not intended here to more than barely touch on the subject of cattle feeding. Too much thought cannot be given to it. Enough has been said to indicate that scarcely any single feeding stuff meets all requirements of a perfect ration and to emphasize the advantage of using mixed feed.

III. SOME FLORIDA WEEDS AND GRASSES AS FEEDING STUFFS.

THE BEGGAR WEED.

Diligent search for a hay-producing plant suitable to Florida soil and climate has been made in recent years. The beggar weed seems to meet these demands to large extent, and deserves most careful consideration. Below is given an analysis of it. The analysis expresses the number of pounds of the different nutrients in 100 pounds of the air-dry plant. By air-dry is meant that the plant, after being cut, was cured by exposing it a short while (a day or so) to the sun, and then allowed to lie under shelter. The plant was not rained on or otherwise wet after cutting. A plant will vary in composition according to the soil, the manuring, season, etc. Hence to get at the *average* composition, many analyses of many plants grown in different places, in different years and under different conditions of fertilizing, should be made. The analysis given here is that of two plants only, cut at different stages of development (one in green seed, the other not yet seeding), grown the same season (the one just passed) and on different soil, one high hammock, twenty or thirty years in cultivation, and not recently fertilized, the other flat pine woods richly fertilized. Alongside of the beggar weed analysis is given the average composition of average meadow hay:

	Beggar Weed.		Average Meadow Hay.	
Moisture	9.16	per cent.	14.30	per cent.
Crude Ash	4.72	"	6.20	"
Crude Protein	11.85	"	9 70	"
Crude Fat	2.92	"	2.50	"
Crude Fiber	29.29	"	26.30	"
Nitrogen-free extract	42.06	"	41 00	"
Nutritive ratio	1 to 7	"	1 to 8	"

The digestibility of the different nutrients in the beggar weed has, so far as I know, never been determined; but assuming it to be equal to that of average meadow hay, its nutritive ratio is as 1 to 7, whereas that of the hay is as 1 to 8—a decided advantage in favor of the weed.

As to the best time of cutting the weed for hay I am not informed, but on general principles would say, before the seeds have matured and the stalk has hardened too much into indigestible fiber. As has been stated, the albuminoids are most abundant in the young and growing parts of plants. As the plant matures, they are transferred to, and accumulate in, the seeds, at the expense of the other parts of the plant. If the matured seeds are quite small, liable to drop off in harvesting or to escape mastication, the albuminoids in them are lost to the animal.

Beggar weed will make two crops of hay. The second crop is said to be less stemmy than the first, and is regarded by some as the very best of hay, when properly cured.

FROELICHIA FLORIDANA.

This weed is sometimes known as cotton head. It flourishes over the northern and western and perhaps other parts of the State. A recent writer in the Times-Union states that he has seen cattle eat it freely. It contains about one-third as much crude protein as the beggar weed, about two-thirds as much crude fat, and somewhat more crude fiber and nitrogen, free extract. Though it may possess considerable value as a nutrient, it is, from a chemical standpoint, vastly inferior to the beggar weed. Assuming that each possess the digestibility of meadow hay, the nutritive ratio of beggar weed is as one to seven and of the cottonhead as one to twenty-three. The plant analyzed was cut August 22, and was in bloom.

SAND SPUR.

The plants analyzed were cut September 12th. The spurs were still somewhat green. If the plants had been cut at an earlier stage of growth, they might have shown better analysis. The crude fat, fiber and nitrogen-free extract, in this grass is about the same in quantity as that in average meadow hay, but it contains but little over one-half as much crude protein.

PURSLEY.

Plant cut while in bloom September 6th. This is a common garden weed and is sometimes used as a pot-herb. Hogs are found of it. The green plant contains about 90 to 95 per cent. of water. The air-dry plant is very rich in protein and fat, poor in fiber and nitrogen-free extract.

CRAB GRASS, BULL GRASS, CROWFOOT GRASS, LOUISIANA GRASS.

The analysis would indicate that these are all good grasses, but they contain considerably less protein than average meadow hay.

WIRE GRASS.

Poor in protein.

SPANISH MOSS.

By this is meant the gray moss that hangs in long festoons on the trees of our Florida forests. I have often seen cattle chewing this moss, more particularly in the winter and early spring. Analysis shows it to possess considerable crude nutrients. Assuming that these nutrients are as digestible as in the case of oat straw, moss possesses considerably more value as a feeding stuff than oat straw. This is merely from a chemical standpoint. Whether or not moss alone can sustain the life of an animal for a considerable time is a question. Chopped up fine and sprinkled over with a little wheat-bran, corn or oat-meal and salt, it might possibly prove of some value.

COTTON-SEED MEAL AS A FEEDING STUFF.

Among Southern food products, there is one which, though coming more into use as its virtues are becoming understood, is still too much neglected. I refer to cotton seed and cottonseed meal (even cottonseed hulls are being fed to great advantage as coarse fodder). The report of the South Carolina Experiment Station for 1888 has this to say of cottonseed meal:

"Chemically considered, a ton of cottonseed meal must be equivalent to two tons of corn for feeding stock, if there are at hand coarse fodders, such as hay and straw, to mix with it. When fed, something like one-tenth of the plant-food contained in it is lost, and is not recovered in the manure. Its feeding value is in the neighborhood of $40, its commercial value as fertilizer about $25. If fed, and the manure saved, its value is then $40x25—2.50=$62.50. If used as a fertilizer, its value is $25. The difference between the two methods of using is, therefore, $37.50."

The same report estimates the following as a suitable daily ration for a milk cow of one thousand pounds, live weight: 10 pounds fodder corn (field cured), 11 pounds oat straw, 20 pounds turnips, 3 pounds corn-meal and 15 pounds of cottonseed meal.

TABLE I.

The analyses in this table down to and including 278 were made at the Florida Agricultural Experiment Station by J. J. Earle. The rest are from various sources and are given for purpose of comparison.	100 pounds of green plant contain		100 pounds of air-dry plant contain							
	Moisture.	Air-dry Matter.	Moisture.	Crude Ash.	Crude Protein.	True Albuminoids.	Crude Fiber.	Crude Fat.	Nitrogen—free extract.	Nutritive Ratio.
A. Beggar weed (Desmodium molle)	52.73	47.27	..	......	......	......	......	......	......	.....
266* Beggar weed (lower part, mainly stalk)	......	......	9.84	3.95	7.00	6.56	36.12	2.30	40 79	......
267* Beggar weed (upper part, leaves and branches)	......	.....	9.13	5.97	15.75	14.17	26.46	3.35	39.34	......
B. Beggar weed	48.00	52.00	......	......	......	......	......	......	......	......
268† Beggar weed (lower part, mainly stalk)	.....	......	8.64	2.48	5.25	4.55	34.95	1.15	47.53	.....
269† Beggar weed (upper part, leaves and branches)	......	.....	9 06	6 50	19.42	16.88	19.62	4 88	40.52	......
Average of the above	50.36	49.63	9.16	4.72	11.85	10.54	29.29	2.92	42.06	1:8‡
270. Cotton head weed (Frœlichia Floridana)	73.33	26.67	10.79	5.05	3.94	3.50	32.55	1.92	45.75	1:23‡
271. Sandspur grass (Cenchrus tribuloides)	68.18	31.82	15.30	4 00	5.26	4.80	27.88	1.90	45.66	1:16‡
272. Wire grass (Aristida)	53.00	47.00	10.15	2.95	3.28	3.06	28.71	1.72	53.19	1:28‡
273. Pursely (Portulaca oleracea)	87.80	12.20	11.92	22.92	22.30	11.81	14.18	4.20	24.48	1:23‡
274. Crab grass (Panicum sanguinale)	......	......	10.65	9.27	8.32	7.44	27.62	2 25	41.89	1:10‡
275. Bull grass (Eleusine Indica)	......	......	12 20	6.78	7.44	6.56	21 53	2.35	49.70	1:12‡
276. Crowfoot grass (Eleusine Egyptica)	......	......	11.73	7.40	8.3	7.21	20.75	1.58	50.21	1:10‡
277. Louisiana grass (Paspalum platycaule)	......	......	10.33	5.75	7.44	6.56	29 30	1.80	45.38	1:12‡
278. Moss (Tillandsia usneoides L.)	......	......	14.85	4.10	5.07	3.92	25.35	2.43	48.20	1:19¶
Clover hay	......	......	11.37	6.23	12.55	.....	26.86	2.44	40.55	1:6
Timothy hay (Phleum pratense)	......	......	10.24	4.11	6.06	......	30.37	2.12	47.10	1:13
Baled hay, "extra fine"	......	......	15.95	3.93	6 20	......	26.60	2.19	45.13	......
Oat straw	......	.....	8.74	4.81	3.82	......	41.52	2.22	38.89	1:28
Cow-pea vines	......	......	14.05	8.41	15.68	......	19.80	2.87	42.17	1:4
Sweet potatoes	......	......	70.63	0.99	1.55	......	1.36	0.38	25.09	.....
Pumpkins	......	......	92.27	0.32	1.11	......	1.49	0.16	4.34	......
Oats	......	......	10.94	2 97	11.38	......	9.85	4 81	60.05	1:6
Indian corn, Dent	......	......	10.09	1.54	10.33	......	2.28	5.10	70.66	1:9
Cow-pea	......	......	14.79	3.20	20.77	.....	4.06	1.43	55 75	1:3
Cottonseed meal	......	......	8.32	7.26	42.39	......	5 69	13.37	22.97	1:1½
Cottonseed (hulls and kernels)	......	.....	7.72	3.16	15.72	......	25.73	18.56	29.09	......
Cottonseed hulls	......	......	10.00	2.79	4.68	......	41.65	3.00	38.79	......
Wheat bran	......	.....	12.28	......	15.07	......	8.71	3.78	54.26	1:4
Green leaves (of trees)	......	......	......	4.00	5.20	......	13.00	1.50	15.20	.....

*266 and 267 are lower and upper part of a plant five feet high and in seed.

†268 and 269 are lower and upper part of a plant two feet high and not yet in seed.

‡On basis of digestibility of meadow hay.

¶On basis of digestibility of oat straw.

BULLETIN No. 12,

—OF THE—

EXPERIMENT STATION

OF FLORIDA,

—AT THE—

STATE AGRICULTURAL COLLEGE.

Lake City, Florida.

JANUARY 1, 1891.

REV. JAS. P. DEPASS, DIRECTOR.

STAFF:

DR. J. C. NEAL, ENTOMOLOGIST AND BOTANIST.
DR. J. M. PICKELL, CHEMIST.
J. J. EARLE, A. B., ASSISTANT CHEMIST.

JACKSONVILLE, FLORIDA:
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1891.

ERRATUM.

On page 17, Bulletin No. 11, occurs this paragraph:

The same report estimates the following as a suitable daily ration for a milk cow of one thousand pounds live weight: ten pounds fodder corn (field cured), eleven pounds oat straw, twenty pounds turnips, three pounds cornmeal and fifteen pounds cottonseed meal.

Instead of fifteen, it should be FIVE pounds of cottonseed meal.

TOBACCO.

An effort was made last year to make extensive experiments in tobacco. Seed of the best quality was obtained and plantings were made on carefully prepared beds as early as December 6, '89. Every month these were continued, and while the seed sprouted well, still in a few days nothing but a few plants were left. The attention of the entomologist was called to it and the fact discovered that the flea beetle was doing the damage, but the discovery was too late to get in an early setting of plants. On June the 14th and 19th, sowings were again made from which a fine stand of plants were obtained. These were set out in the early part of July, and by the middle of September were cut and stored away in the barn. The plants immediately suckered out, and before a killing frost another crop had been made. I used the cabbage patch, planting in the same hills from which the cabbage had been taken. The crop was a luxurient one.

This planting demonstrates that every vegetable grower can make a paying crop of tobacco by having his plants ready for the field by the time his vegetables are gathered and shipped.

The two crops which a planting makes will have been housed before the time of fall or winter gardening begins. Thus their lands can be kept in good condition by cultivating growing crops. Stable manure, cottonseed meal, or good wood ashes, have been found to be specially adapted to the plant.

All tobacco growers insist on cooking the soil by burning brush and log heaps freely for seed beds. I tried burnt and unburnt beds this year and last, both on old and new land, and got plants both ways. A rather damp place, with a sun exposure, is the best. If, however, the bed can be irrigated without packing the soil, it will doubtless serve every purpose.

Since writing the above, Mr. Henry J. Fenton, the F. C. & P. expert, has examined my fall crop of tobacco and pronounced it as good as any he has seen grown in Florida. This is an encouraging fact, as the opinion of some was that late tobacco did not cure well.

TO KILL OR PREVENT THE FLEA BEETLE—BY DR. J. C. NEAL.

Apply Pyrethrum Powder (*Insect Powder*) freely every other day. Use fresh powder and the insects will soon disappear; or

To one gallon air-slaked lime add one fluid ounce carbolic acid, or one ounce turpentine. Mix thoroughly by sifting. Apply this freely.

NOTES.

I cannot in too strong terms urge our farmers and truck growers to plant tobacco freely. It is demonstrated within a few years past that Florida produces as valuable a leaf as Cuba. There is no doubt but that our tobacco is manufactured into cigars and sold all over the country as Havana.

The methods of curing are simple, and our people will soon adjust themselves to it if they will undertake it. Thousands of acres of our light sandy soils, both pine and hammock, cheaply fertilized, will produce both wrappers and fillers of a fine texture and excellent flavor, and in a few years, however large the crop, the demand will increase.

I give below a paper, prepared by Mr. Henry J. Fenton, who is the tobacco agent of the F. C. & P. This great railroad, always in the front rank to help Florida, through its President, Mr. H. R. Duval, and its General Superintendent, Captain D. E. Maxwell, has for several years tried hard, at great expense of time and money, to introduce the culture of tobacco in Florida. To some extent the effort has been successful. The management of this road is still willing to assist. By consent, I publish Mr. Fenton's circular as information in the interest of this important and growing industry.

FLORIDA CENTRAL & PENINSULAR R. R. CIRCULAR.

There was produced in Gadsden county this year about 650 acres of tobacco, not including the plantations of Messrs. Straiton & Storm, (the Owl Cigar Co.), and those of Messrs. Carl Voght & Sons, and Messrs. Schoeder & Bon, which grew about 700 acres, making a total of about 1,350 acres. The well known success of the three firms named makes it unnecessary to further refer to them, so I will only mention the result of the 650 acres grown by others. The various crops planted ranged from one to twenty acres each. The average yield per acre was about 392 pounds, and the price realized averaged about twenty-five cents per pound, making a total of 254,800 pounds, selling for $63,700.00, or $98.00 per acre, the cost of producing which did not exceed $48.00 per acre.

These results prove that tobacco planting is most profitable in Florida, and encourage the Florida Central & Peninsular Railroad Company to endeavor to further stimulate its production, to which end I beg to offer the following suggestions upon the cultivation of tobacco in this State, in the belief that the most satisfactory results will follow their observance:

1. SELECTION OF SEED.

a. Seed from the Vuelta de Abajo District of Cuba is beyond doubt the best for this State, since it produces both a good filler and wrapper.

b. It is demonstrated that plants raised from pure Vuelta de Abajo seed produce the best tobacco seed, the seed of the first and second year's planting being the best. That is to say, plants from Vuelta de Abajo seed planted in 1891 will produce plants which will supply seed for the planting of 1892, and plants thus grown in 1892 will supply seed for the following year. But the plants of 1893, being two generations from Cuba, do not produce good seed. The tobacco from the first year's planting does not grow large enough for a wrapper, and does not produce enough tobacco to be profitable to the grower as a filler. But it does produce a *seed* which is good for the next year planting. It is therefore necessary that a sufficient quantity of pure Vuelta de Abajo seed be planted to keep up the stock, because, as shown above, after three generations the seed loses its good qualities.

2. TIME TO PLANT SEED.

a. The proper time to plant seed is in January, February and March. The two former months producing the best results, while the sowing in March is necessary for re-setting and late planting.

3. LOCATION AND PREPARATION OF SEED BEDS.

a. It is well to select two locations for seed beds if possible, one in a low, damp place, and the other on rich uplands. By this the disastrous results of a dry or wet season may be avoided. It is wisest to plant a number of small beds which can easily be covered and protected from frost. A simple muslin cover on stretchers is the best.

b. Upon the spots selected, burn an abundance of wood and brush, for the purpose of killing insects, and the ashes to serve as fertilizer.

c. If any roots remain, remove them if possible, and work the ground thoroughly with a plow or hoe, pulverizing well, sloping the surface slightly to prevent water standing on the beds.

d. Sow the seed and rake it in. One teaspoonful of seed should be sown to each square rod of land, which will produce sufficient plants for setting one acre. In order to sow the seed evenly, it is well to mix it with meal or wood ashes. Should the weather continue dry, the beds must be watered as may be necessary.

4. TRANSPLANTING.

a. Plants are ready to be put out when from three to six inches high, and the work is done similarly to the manner in which cabbage plants are handled. The roots should be loosened with a sharpened stick or fork, and care used not to bruise the plant in any way.

5. SOIL FOR FIELDS.

a. Soil for fields should be of a sandy loam, with a red clay subsoil. Avoid surface clay land. Hammock land is the best, but old fields produce good tobacco when properly fertilized.

6. FERTILIZERS.

a. Cow pen manure and cottonseed compost make good fertilizers. Of the latter, fifty to one hundred bushels per acre should be used, according to the land.

7. PREPARING FIELDS.

a. The fields should be well worked, and made as mellow as possible, and fertilizers well worked in.

b. The field should be made into small rows (two small furrows thrown together). Rows to be from three to four feet apart, and plants set from fifteen to eighteen inches apart, depending upon the richness of the land.

8. CULTURE OF THE PLANT.

a. Fields must be kept well cultivated and free from weeds. The soil should be kept mellow, and should it, for any reason, become hard or crusty, it must *at once* be worked with a team or hoe.

b. As soon as the bloom shows, the bud should be broken off, leaving on the top of the plant a good, healthy-looking leaf. Some difference of opinion exists as to the best time for topping, but the best results have been obtained as above.

c. After a plant is topped a sucker will grow to each leaf, which should be picked off when two or three inches long, and never be allowed to remain on the stalk and be gathered.

9. HARVESTING.

a. Tobacco should be harvested by cutting the entire plant when it is thoroughly ripe, and not by stripping its leaves from time to time, as is sometimes done.

b. A plant is sufficiently ripe for harvesting when the leaves near the top will snap when pinched on the under side between the stems. The ripeness of a plant cannot always be determined by its color.

10. TOBACCO SHEDS.

a. These should be so built as to give a good circulation of air from bottom to top, and arranged to be closed when necessary.

b. A shed 60x32 feet, with 12-foot posts, is of sufficient size to cure five acres of tobacco. Sheds of this size, and smaller, are best, as larger ones cannot be well ventilated, which is the first importance in curing tobacco. Plans and speecifications for sheds will be sent upon application.

11. HANGING IN SHEDS.

a. After a plant is cut, it should, if possible, not be laid upon the ground, as sand will adhere to it, causing trouble when the leaf reaches the factory.

b. Plants should be hung seven to eight inches apart both ways.

c. They may either be tied to a lath or pole, or the stalk split and a pointed lath run through it, putting six or eight plants on a lath. Poles or laths should be hung in the manner that will best economize space.

d. The sheds should be well ventilated until the tobacco is well wilted down and the plants hang clear of each other.

12. PREPARING FOR MARKET.

a. When the main stem of a leaf can be pinched near the stalk and show no sap, the leaves are ready to be stripped.

b. The leaves should be carefully sorted, ragged, poor and ground leaves being placed together, irrespective of sizes; also small coarse leaves from the top. The good leaves should be divided as to size, long together, and short together.

c. They are then to be tied into packages, or hands, wrapper packages to contain from thirty to thirty-five leaves and filler packages to have from from forty to fifty leaves. In placing them in packages, each leaf should retain its natural shape as stripped from the stalk, and not in any case be smoothed out flat.

d. In bulking away or boxing, keep the different grades or kinds of packages by themselves, and pack by lapping the tips of the packages. When boxing, use only clean dry boxes, leaving small space between the ends of the packages and the box to prevent molding. Do not let the boxes remain on the ground.

13. INSECTS.

a. Insects may threaten plants at any time. The cut-worm usually appears immediately after transplanting. The most effectual remedy is one tablespoonful of Paris Green to four quarts meal or flour, mix well and sprinkle the plants. A perforated can or pepper box can be used for this purpose.

b. The horn and bud-worms appear while the plant is in its growth and must be quickly picked off or the plant is ruined. The horn-worm fly can be destroyed by use of Jamestown (gympson) weed blossoms poisoned with cobalt. Place the blossoms in the field at night on a stick, and the fly is killed by sucking the poisoned honey.

The undersigned has been to Cuba and personally purchased seed for 1891 planting, to supply stock seed for planting in 1892 and 1893. I have also secured a limited amount of seed grown in Florida from 1890 planting, of the pure Vuelta de Abajo variety. Upon application on and after January 1st, 1891, both qualities of this seed will be supplied free to growers whose plantations are located within ten miles of the Florida Central & Peninsular Railroad. All applications must contain the maximum acreage proposed to be planted, as Florida grown seed is scarce this year, and must be distributed carefully to the greatest possible area.

It will afford me pleasure to give you any further information desired, and if at any time you wish me to visit your plantation for the purpose of directing the cultivation, gathering or curing of crop, I will gladly do so if you will furnish transportation from your F. C. & P. R. R. station tofield and return.

Address all communications to Quincy, Fla.

Yours truly,

HENRY J. FENTON,
Tobacco Agent.

LONG OR BLACK SEED COTTON.

The past season was a most disastrous one for this crop.

In the early part of the season the prospect for an immense yield was exceedingly favorable. The plant grew off well, was healthy, putting on forms early and numerously. About the middle of July the dreaded boll worm made its appearance and continued its ravages until the close of the season. In the latter part of August the rust developed quite rapidly, and by the middle of September its fatal effects were manifested.

All experienced farmers know that fresh land is the best for cotton. In conducting my experiments I select the oldest land for the purpose of testing the effect of fertilizers in producing a paying crop. The land on which this crop was grown was doubtless an Indian patch, but it is known to have been in cultivation over thirty years.

The following five plots consisted of two thirds of an acre each, planted March 25, with the very best sea island seed, obtained through H. F. Dutton & Co., from South Carolina:

1.—Was fertilized with black cottonseed meal. Result, 221 pounds per acre.

2.—One ton of farm compost (the formula of which was reported in Bulletin 11); yield, 430 pounds per acre.

3.—400 pounds cottonseed meal and 40 pounds acid phosphate; 385 pounds per acre.

4.—225 pounds cottonseed meal and 235 pounds pot-ammoniac; 392 pounds per acre.

5.—203 pounds cottonseed meal and 34 pounds acid phosphate; 275 pounds per acre.

The following six plots, 1-14 of an acre, each, were planted April 11, in land where once a house stood. The first two were planted with common Florida seed. The second two with the C. C. or what is commonly known as the Alford, and the last two with the best Sea Island:

1.—Not fertilized; yield, 242 pounds per acre.

2.—Fertilized with farm compost; 1,000 pounds per acre; yield, per acre, 477 pounds.

3.—Unfertilized; 535 pounds.

4.—Fertilized with farm compost, 1,000 pounds per acre; 875.

5.—Not fertilized; 372 pounds per acre.

6.—Fertilized with farm compost, 1,000 pounds per acre; 433 pounds.

The cost of the farm compost is $3.33 per 1,000 pounds.

The yield of the above plots was not affected to any marked degree by rust. The inequality of yield is due to the boll worm. The C. C. or Alford cotton is decidedly the most prolific I have ever tried, and it uniformly turns out one pound of lint to three pounds of seed cotton, and the lint is good.

I made an experiment again this year by planting the 4th of June. The season was too wet, and the crop suffered with boll worm and rust. The yield per acre on unfertilized plot was 65 pounds, and on the fertilized 152 pounds.

FOREIGN COTTON.

The experiment was with short and long staple. I had only seed enough, of each variety, to plant a row 35 feet long. The farm compost was used at the rate of 1,000 pounds per acre. The object in view of using it alone was to find the value of lint of each variety and the yield per acre, under the same manner and system of cultivation. The planting was made the 27th of March.

The short cotton was—

1.—From Bombay, India; lint poor; yield, 520 pounds per acre.

2.—From Pernambuco in Brazil; lint inferior; 416 pounds per acre.

3.—White Peruvian; common lint; 546 pounds per acre.

The long staple was—

1.—From Egypt; staple medium; 572 pounds per acre.

2.—From South Sea Islands; staple medium; 546 pounds per acre.

3.—From Figi; staple very fine; 624 pounds per acre.

4.—From Tahiti; staple very fine; 624 pounds per acre.

The Payta-Peruvian, Maranham and Pernambuco grew unusually large, but did not fruit. I am indebted to the firm of H. T. Dutton & Co., of Gainsville, Fla., for procuring the seed of foreign cotton. Very fine samples of the above were exhibited at the Farmers' Alliance Exhibition at Ocala, December 3, 1890, but were destroyed by fire, a few hours after they were placed in position, through the carelessness of a youth who tossed his match into the cotton, after lighting his cigarette.

RICE.

In 1889 five-eighths of an acre was planted in rice, and fertilized with rotted bone at the rate of 500 pounds per acre. A heavy rain just after it came up ruined the stand, and it had to be replanted. The land was old, sandy, rolling and dry except a small part, which was wet and springy. In the wet land it grew off rapidly, and did well, but in the dry some of it failed to head. The yield was 14 2-5 bushels per acre.

The same plot was planted last year and fertilized with farm compost, at the rate of one ton per acre. The seasons were favorable, th stand good but not thick enough in hill, nor were the hills as near each other as they ought to have been. It was observed that when the hills were close together, about ten inches apart, and the plants thick, that the growth and yield were better. One-eighth of the plot was so dry and thirsty that it did not mature grain.

It was planted on the 25th of March, hoed April 18th and May 20th, and plowed May 9th and 22nd, and June 20th. The yield was 21 bushels.

The crop is an easy one made if planted early. Uniformly the first part of March is the best time to plant. This gives the rainy season for it to mature in, and then the stubble stools out, making good forage, even sometimes maturing grain, but of an inferior quality.

The land should be prepared by flushing with a good one-horse plow, a two-horse is better, and then harrowed smooth. The rows ought not to be more than three feet apart, and the fertilizer, if any is used, should be evenly distributed, covered with two furrows and allowed to remain at least a week or ten days before planting. When ready to plant open with a bull tongue and either sow or drop seed ten inches in drill. If sowed, plant thick enough so as to leave eight or ten shoots in the hill, when chopped to a stand. If no fertilizer is used, the seed can be planted as soon as the ground is prepared.

Light sand hills or very dry land is not adapted to rice. Almost every farm in Florida has either some level or moist places on which enough can be made for home use. The difficulty of having it cleaned has been overcome by a few by shipping it to Charleston, S. C., or Savannah, Ga., to a merchant mill. This can be done quite cheaply. Should the farmers in any section conclude to make rice for profit they will find it easy to sell, and at prices ranging from 80 cents to $1.00 per bushel. A very large area of Florida known as flat lands, will, without fertilizer, grow from 15 to 30 bushels per acre. A crop of rice instead of cotton on such lands would be more remunerative. Besides the straw is a valuable forage, preferred to either hay or corn fodder by many who have tried it.

Farther experiments will be made in rice, both on high and low lands. I am satisfied it is a valuable crop for Florida, and if a sufficient area was planted mills, for cleaning it would soon be established at our centers.

SORGHUM.

Quite a number of varieties of sorghum seed were sent me from the Department of Agriculture at Washington, requesting that they be planted and reported on. The following were planted: Early Orange, Early Amber, Links Hybred, cross of Amber and Orange, Red Liberian, Undendebule, Neayæa, Kansas Orange and unknown cross of India. On land lightly fertilized and unfertilized they all grew well, some canes reaching as high as eighteen feet, and one and a half inches at base. The cross of Amber and Orange averaged up the best as to uniform size and yield of juice. The yield of syrup was good, but of inferior quality compared to sugar cane. The seed were planted April 11th, and the cane was ready to grind by August 1st. The Department at Washington is experimenting largely in sorghum, with a view of making it a producer of sugar and fine grades of syrups. In the event that a simple and cheap method is discovered.

NOTE.—Other experiments of an interesting character are in progress and will be reported in due time.

The laboratory is now worked to its utmost capacity, and hence analyses of rocks, soils, etc., will be declined.

JAS. P. DEPASS,
Director.

ASHES AS A FERTILIZER.

Ashes are generally regarded as a *potash* fertilizer, and the fact that they are equally a *lime* fertilizer is too often left out of view.

The effect that they have on the physical condition of the soil, as well as their strictly manurial value, should always be taken into account. Lime, of which they contain from about 20 to 50 or 60 per cent, benefits clay soils by rendering them more open, pulverulent and warm, and light soils by making them more compact and retentive of moisture. Potash and soda, on the other hand, tend to render clay soil still more adhesive, breaking up in hard clods. It is, therefore, doubtful whether the good effects of the lime of wood ashes on clay soils would not be counterbalanced by the bad effects of the potash. Wood ashes have been found especially valuable in light-soils, rendering them compact and capable of drawing up moisture by capillary action. On soils rich in humus, it has been observed that potash causes tobacco to grow rank and coarse, "probably because of nitrogen supplied to the crop," says Prof. Stores, "by the action of potash on humus." This is a point worthy of consideration by those having orange groves on hammocks. Wood ashes are especially valuable in correcting "sourness" of soil and in rendering soluble salts of iron harmless by rendering them insoluble.

The writer was recently asked to advise a gentleman which to use, wood ashes at $21 a ton, or cottonseed hull ashes at $30 a ton, the latter analyzing 28 to 35 per cent. of potash, and 8 to 10 per cent. phosphoric acid. From the standpoint of cost only, the latter is vastly to be perferred. Cottonseed hull ashes contain from 17 to 42 per cent. (average 24 per cent.) of potash; 3 to 13 per cent. (average 8 per cent.) of phosphoric acid; 9 per cent. of lime (average). Wood ashes contain ½ to 8 or 10 per cent. (average about 5¼ per cent.) of potash; ½ to 4¼ per cent. (average 1¾ per cent.) of phosphoric acid, and 35 per cent. (average) of lime. A simple calculation will show that $30 invested in cottonseed hull ashes, of average composition, will buy at $30 a ton, 480 pounds of potash; 160 pounds of phosphoric acid, and 180 pounds of lime. The same amount ($30) invested in wood ashes, of average composition, will buy, at $21 a ton, 150 pounds of potash; 50 pounds of phosphoric acid, and 1,000 pounds of lime. It will, therefore, be seen that $21 a ton for wood ashes is a very dear price for potash and lime. It would be far cheaper, to buy one's potash in the form of cottonseed hull ashes, and one's lime direct as lime from the kilns. It should, however, always be borne in mind that ashes are exceedingly variable in quality, and that it is never safe to buy them except under guaranteed analysis.

Wood ashes, as they come into market as fertilizers, contain from about 20 to 50 or 60 per cent. of lime, ½ to 3 or 4 per cent. of phosphoric acid (average about 1¾ per cent.), 1 to 8 or 10 per cent. of potash (average about 5 to 6 per cent.). This wide variation is due partly to impurities (sand and dirt), partly to the fact that the ashes (or the wood) have been, either by accident or design, more or less leached, and partly to the fact that the ash of different kinds of wood contain the various ash constituents in widely different quantities. The following analyses of the pure ash of different kinds of wood, made at the Georgia Experiment Station, illustrate the latter fact very forcibly:

CONSTITUENTS OF DIFFERENT KINDS OF ASH.

Pure ashes of the different woods contain the following per cent. of the different ingredients:	Potash.	Phosphoric Acid.	Lime.	Magnesia.
Dogwood	28.04	8.51	38.93	6.80
Sycamore	23.17	12.23	31.62	0.62
Post Oak	21.91	9.00	46.39	6.88
Ash	46.04	3.58	23.57	0.60
Red Oak	24.66	10.55	48.26	5.38
Hickory	28.60	11.97	37.94	10.04
White Oak	46.16	9.48	29.85	3.43
Magnolia	19.54	8.75	38.94	8.05
Georgia Pine	15.35	3.82	55.24	6.25
Yellow Pine	19.70	4.18	65.53	3.20
Black Pine	14.30	4.33	58.98	0.50
Chesnut	18.10	6.76	49.18	2.11
Old Field Pine	3.85	4.11	67.73	6.54

The trees selected for the foregoing analyses were of medium age, and grew as nearly as possible under similar conditions. No bark was included in the wood from which the ashes were made. Special pains were taken to get a pure ash, free from earth, sand, etc. It will be noticed that the ash of the White Oak and that of the Ash are the richest in potash, that the quantity of potash in the ash of different species of oak varies widely. The same fact is observable in the pines, which show the lowest per cent. of potash but the highest per cent. of lime of all the ashes analyzed.

The beggar weed will serve to illustrate the folly of burning the vegetable matter from the soil in cases where it is practicable to plow it under and allow it to decay in the soil. The ash of the beggar weed is very valuable as a fertilizer, a ton of the pure article being estimated as worth about $29. But to make one ton of the ash about twenty tons of the "cured" (or sun dried) weed would be necessary. These twenty tons contain about 758 pounds of nitrogen, worth at 15 cents a pound $113.70. By slow process of decay in the soil a large part, if not all, of this nitrogen, would become available as plant food; whereas, if the weed is burned, it is dissipated into the air.—J. M. PICKELL.]

281.—ASH OF PINE STRAW.

[ANALYSES BY J. J. EARLE.]

OLD STRAW GATHERED FROM THE GROUND IN THE FOREST. 100 LBS. OF THE STRAW CONTAIN 1.65 LBS. OF ASH.

THE ASH CONTAINS.	PER CENT.	AMOUNT IN 2,000 LBS.
Sand and insoluble matter	55.90	1,118.00
Lime	14.47	289.40
Phosphoric acid	4.28	85.60
Potash	2.08	41.60

Valuation per ton, $3.79.

In this and the following estimates, phosphoric acid is put at 2 cents and potash at 5 cents a pound.

282.—ASH OF PINE BURR.

100 LBS. OF THE BURR CONTAIN 1.09 LBS. ASH.

THE ASH CONTAINS.	PER CENT.	AMOUNT IN 2,000 LBS.
Sand and insoluble matter	45.31	906.20
Lime	10.30	206.00
Phosphoric acid	3.31	66.20
Potash	6.92	138.40

Valuation per ton, $8.24.

285.—ASH OF PINE BARK.

100 LBS. OF AIR-DRY BARK CONTAIN 3.6 LBS. OF ASH.

THE ASH CONTAINS.	PER CENT.	AMOUNT IT 2,000 LBS.
Silica and insoluble matter	8.66	173.2
Lime	30.92	618.4
Phosphoric acid	4.28	85.6
Potash	4.21	84.2

Valuation per ton, $5.92.

286.—ASH OF OAK LEAVES.

100 LBS. OF AIR-DRY LEAVES CONTAIN 4.70 LBS. OF ASH.

THE ASH CONTAINS.	PER CENT.	AMOUNT IN 2,000 LBS.
Silica and insoluble matter	30.51	610.2
Lime	29.03	580.6
Phosphoric acid	3.35	67.0
Potash	3.74	74.8

Valuation per ton, $5.08. These were old leaves gathered up from the ground.

279.—ASH OF BEGGAR WEED.

100 LBS. OF THE GREEN PLANT CONTAIN 2.36 LBS. ASH. 100 LBS. OF THE GREEN PLANT CONTAIN 0.92 LBS. NITROGEN.

THE ASH CONTAINS.	PER CENT.	AMOUNT IN 2,000 LBS.
Sand and insoluble matter	8.01	160.20
Lime	25.40	508.00
Phosphoric acid	11.52	230.40
Potash	24.10	482.00

Valuation per ton, $28.70.

Forty to forty-five tons of green Beggar Weed will yield one ton of ash.

Twenty to twenty-five tons of air-dry Beggar Weed will yield one ton of ash.

One ton of air-dry Beggar Weed contains about 37.8 lbs. of nitrogen.

280.—ASH OF RAG WEED.

100 LBS. OF THE GREEN PLANT CONTAIN 3.46 LBS. ASH.

THE ASH CONTAINS.	PER CENT.	AMOUNT IN 2,000 LBS.
Sand and insoluble matter	2.70	54.00
Lime	22.52	450.40
Phosphoric acid	9.60	192.00
Potash	31.11	622.20

Valuation per ton, $34.95.

80 (*a*).—ASH OF SPANISH MOSS.

100 LBS. OF MOSS CONTAIN 3.65 LBS. OF ASH.

THE ASH CONTAINS.	PER CENT.	AMOUNT IN 2,000 LBS.
Sand and insoluble matter	25.79	515.8
Lime	13.04	260.8
Phosphoric acid	3.48	69.6
Potash	13.39	267.8

Valuation per ton, $14.78.

The analyses of Pine Straw, Beggar Weed, Oak Leaves and Rag Weed Ash were made to determine their relative value not only as soilers but as litter for stables, cowpens, etc. Another year, or as we have opportunity, other analyses of these and other grasses and weeds will be made for the same purpose. By studying these analyses our people will see that at their very doors material is wasting which, if properly used, would make their lands productive and their homes abound in plenty.

JAMES P. DePASS, Director.

BULLETIN No. 13,

from the —OF THE—

EXPERIMENT STATION

OF FLORIDA,

—AT THE—

STATE AGRICULTURAL COLLEGE.

Lake City, Florida.

APRIL 1, 1891.

REV. JAS. P. DEPASS, DIRECTOR.

JACKSONVILLE, FLORIDA:
DACOSTA PRINTING AND PUBLISHING HOUSE.
1891.

GENERAL INFORMATION.

It may be well to state for the information of all concerned that the bulletins are only designed to give publicity to what actually transpires on the station. I am not publishing a newspaper nor the views and theories of newspaper writers, but facts as they develop. I am not publishing them in the interest of other States but for Florida. The bulletins of other States have been of service to me, but to give the progress of agriculture in other Stations, or States, except as it may affect Florida, would be to invade the province of the newspaper. They are not written nor published to gratify the truly scientific alone, but mainly for the agricultural classes. Hence, I avoid as much as possible, tables and technicalties. which to some are confusing, write plainly, giving details as to methods and cultivation on all subjects that all may understand. The Florida farmer can rest assured that what I report in the bulletins issued from this station is correct and not exaggerated.

The line of experiments and investigations and analyses as laid down in Section 2 of Hatch Act establishing Experimental Stations, has been carefully and extensively pursued in every respect, with one exception, to-wit: the physiology of animals, their diseases and remedies for the same. In due course of time I hope to have a skilled veterinary surgeon who will be able to give this department his undivided attention.

It will be seen from Section 4 that I am forced to send bulletins to every farmer who applies for them and to every newspaper published in the State as far as the means of the station will admit of. The design of this section was to assist the farmer and give him the facts as they occur. It is gratifying also to state that the applications for bulletins come by every mail both for back numbers and future issues, and it is a matter of regret that back numbers of several editions are exhausted. Beginning two years ago without a mailing list, it now requires an issue of over 7,000 copies to supply the demand, while letters from all over the State are constantly received appreciating the work the Station is doing and encouraging its officers in renewed efforts in behalf of our agricultural interests. I give below the sections of Hatch Act referred to above, which I hope all interested parties and especially newspaper writers will read carefully:

"SEC. 2. That it shall be the object and duty of said Experiment Stations to conduct original researches or experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops, the capacity of new plants or trees for acclamation; the analysis of soils and water; the chemical composition of manures, natural or artifical, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States and Territories.

"SEC. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the station will permit. Such bulletins or reports, and the annual reports of said stations shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the Postmaster-General may from time to time prescribe." JAS. P. DEPASS, DIRECTOR.

IRISH POTATOES.

NO. I.

The experiment in Irish potatoes last year embraced seven varieties that were generally planted in Florida. An effort was made this year to secure the same kinds of seed, with others, but the market only supplied the Beauty of Hebron and Burbank.

These were tested on land which for two years was planted in garden vegetables in the fall and spring and tobacco in the summer.

The land was fairly good, springy but well tiled. The plot having had clean culture for two preceeding crops there was but little grass upon it.

It was prepared by bedding out rows four feet apart. The water furrow was opened and then fertilized. With six-inch bull tongue manure was covered and with same plow furrow was reopened. This mixed the soil and fertilizer.

The potatoes were cut as nearly as possible with two eyes to each piece and put in drill without reference as to whether the eyes were up or down. A bed of four furrows with turn plow covered the seed. February 25th the beds were sided with turn plow and dirt thrown back. March 4th the middles were broken out by turn plow and on the 20th of March a twelve-inch sweep was run between the beds. By April 10th new potatoes were as large as hen and goose eggs, and by the 10th of May the crop was matured. They were dug the 2nd of June and did not suffer by remaining in the ground, but the season was dry.

It would be difficult to determine which of the two varieties were the finer potato as to size and appearance.

Five experiments were made as to fertilizer. Bowker's or Strowbridge Vegetable Manure, Mapes and Paine's Potato Food were brought in competition with each other, together with compost No. 1 and No. 2, made on the station.

The results can be seen by the following statement:

First Part of First Plot of seven rows, three of which were planted with Burbank and fertilized with compost No. 1 at the rate of 5,200 pounds to the acre, costing $15.21. Value, per ton, $5.85. Yield, 183 bushels.

Second Part of First Plot.—Four rows planted in Beauty of Hebron. Same compost and quantity as above. Yield, 162 bushels.

Plot 2—*1st Part.*—Three rows. Fertilized with compost, No. 2, two tons per acre. Cost, per acre, $15.64. Cost, per ton, $7.82. Burbank. Yield, 166 bushels.

Second Part.—Four rows, Beauty of Hebron. Same compost. Yield. 274 bushels.

Plot 3—*1st Part.*—Burbank. Fertilized with Bowker's Vegetable Manure, 832 pounds per acre. Cost, per acre, $17.47. Cost, per ton, $42—delivered. Yield, per acre, 263 bushels.

Part 2.—Beauty of Hebron. Yield, 238 bushels.

Fourth Plot—*1st Part.*—Burbank. Mapes fertilizer. Cost, per ton, delivered, $44 00; 832 pounds per acre. Cost, per acre, $18.50. Yield, 243 bushels.

Part 2.—Beauty of Hebron. Yield, 217 bushels.

Fifth Plot, *Part* 1.—Burbank. Paine's Potato Food, 832 pounds per acre. Cost, per acre, $12.48 Per ton, $30. Yield, 208 bushels.

Part 2.—Beauty of Hebron. Yield, 196.

NO. 2.

The land selected was the eastern slope of a dry and sandy hill. The plot was prepared the same as above and planted the same day, the 31st of January. It was worked, gathered at the same time, and fertilized the same way. It was the exact counterpart of No. 1 in every respect, except the land was poor and thirsty. With the exception of 1-27 of an acre the plot was in fruit trees and they had the mastery. The potatoes among them did nothing worth speaking of, but the trees finely. Where there were no trees the stand was poor, but the potatoes very large. The fertilizer used was compost No. 1. The yield per acre, 55 bushels.

NO. 3.

The only difference between this plot and No. 1, was that the rows were three feet apart and fertilized with compost No. 1 at the rate of one ton per acre. It was planted March 20th, and the yield in round numbers was 190 bushels to the acre.

REMARKS.

The vines on plots 1 and 3 were luxuriant, of a deep green, but not over-grown, and the stand almost perfect. The potatoes grew and matured evenly. On second plot the vines were of good size, but light green.

The object had in view in placing so much more compost per acre than the commercial fertilizer was to get as near as possible an equitable proportion of each as to cost and production. It will be seen that the cost of compost is less, but when the handling of it is considered the difference will not be worth mentioning. It is a clear deduction therefore that in making potatoes commercial fertilizers are the best so far as easy work is concerned, since the labor of making and handling the composts is greater, and then the compensation is not sufficient to warrant their use, unless they improve the land more than commercial fertilizers, which is an unsettled question. It would appear that if plot 3 had been fertilized in the ratio as No. 1 was, the yield would have been much larger. But this or the best method can only be settled by repeated trials.

Experiment No. 2 was made to test two points, viz: 1st.—If potatoes planted among fruit trees and highly fertilized would be a success; the result is against it. 2d.—The effect of Station composts on high and dry soil. The result was better than expected, and I propose to prepare one especially another year for such land.

The potato crop is easily and cheaply made, so far as the item of work is concerned, and when the land is well drained and moist, for when dry it cannot be relied on, it is a sure crop. Heavy fertilizing is an absolute necessity. It is wasting money to plant even rich soil without liberal fertilization.

The crop ought to be a profitable one every year to Florida, if a sufficient quantity can be raised to the acre, whether the northern crop be a large one or not, since it matures at a time when the northern potato has lost its flavor and is not so palitable.

RYE.

In the spring of r889 I found a small plot of crimson clover, growing luxuriantly on one of the richest spots of the Station, which had been highly fertilized. It inspired the hope that this annual, a native of Southern Europe, had found a home in our State. I purchased several bushel of seed and distributed them in various sections of the State, besides experimenting with them myself in a number of ways. I failed to secure anything like a stand, and this was the uniform experience of others. Supposing the seed defective I tried those raised on the Station with like results. Repeated trials have been equally fruitless.

Southern rye and oats do measurably well on our ordinary pine lands without fertilizer, but they do not grow rank enough to furnish a good pasture. When broadcast the stand of rye is not thick enough. This in some places is caused by the flea beetle and grasshopper, but generally by improper covering, grass stuble and too small an amount of seed per acre. Rye, unlike oats, does not require deep covering, but the field must be clear of clods, weeds and grass stubble.

The following experiments in rye begin a series to determine the best method of furnishing green forage with it during the winter months. The land selected was the oldest and poorest on the farm and said to be an old Indian field. For over thirty years it had been planted in various field crops without fertilizer. Lying on the slope of a hill and being sandy, with clay at least ten feet below the surface, it was subject to washing by heavy rains and has thus suffered on two occasions within the past two years. Peas and corn planted on it did not pay the expenses of the crops. I made this selection with the object in view that if so poor a piece of land would prove profitable it would not only encourage any farmer or fruit grower who owned similar land to follow the experiment, but that it would induce those who had better soil to try it and thus reap a more luxuriant harvest.

Three plots were planted as follows:

The first consisted of one acre. The land was broken up the 6th of October by a New South plow about four inches deep. It was then harrowed smooth by a Clark's cutaway harrow. Deep furrows were opened twenty-four inches apart. In these the manure was drilled as follows: One-half with 2,200 pounds of green stable manure, and the other half with 2,800 pounds of green cow manure. There was also placed in these drills 200 pounds nitrate of soda, 100 pounds of acid phosphate 100 pounds of cottonseed meal and 100 pounds of kainit. The drills were then covered and re opened by a four-inch bull tongue. One bushel of seed was sowed and covered by the same plow, when the whole plot was leveled by a two-horse wooden roller. Rating the seed at $2 per bushel and the hands and horses at $1 per day each, the cost was $25. The season was dry at the time and continued so, with but little rain for several months. I began cutting for feed on the 29th of November, when the rye was about eight inches high, using a reap hook, until the 2d of February, going over the patch one and a half times. There was cut off this acre 10,000 pounds. Had I continued cutting, and it would have admitted of three, as much more would doubtless have been reaped. But having other pastures coming in and desiring to note whether the first and second cutting would seed, I ceased and obtained an average yield of seed on unfertilized Florida soil. No other work was done on this plot after seeding.

The second plot was seeded the 28th of October. It was prepared by cross-harrowing with cutaway harrow instead of plowing. Half the patch was laid off as above and the same formula used, excepting the nitrate of soda, but it was not rolled. The other half had manure broadcast harrowed in, then sowed broadcast and harowed again. That portion which was drilled grew off more readily and luxuriantly, producing to all appearances three times as much as that which was broadcast. This plot was pastured by seven grown cattle and two colts, and lasted two months. There was nearly one and three-fourths acres in the plot. By cross harrowing the cost is grealy lessened. On light land Clark's cutaway harrow, as late as the 28th of October, broke down, cut up and covered, by the time seed were harrowed, fennel and other weeds six feet high. The cost of this plot outside of stable manure, was $12.50.

THIRD PLOT.

As late as the 10th of January I sowed another plot. It was flushed with turn plow. One bushel seed was sowed broadcast and harrowed in with Clark's cutaway harrow. No fertilizer was used. The land had been planted in peas the past summer and was in better condition than the other plots. The stand was good. The seasons were moderately fair, but the growth slow. It was grazed by both cows and colts, but did not respond as readily after being pastured as that which was sowed earlier and fertilized. The experiment suggests that pastures can be planted in rye at intervals as late as the middle of January with profit to the stock raiser.

From the above the inferences may be drawn:

1st. That rye planted in drills pays better than broadcast.

2d. That green food for winter and spring use can be easily and cheaply made on old and poor land.

3d. That a plot of ⅛ of acre sowed in October, and others in November and December, and richly fertilized as in plot 1 or 2, will furnish ample green forage for a horse and cow through winter and early spring.

4th. That it is very injurious to pasture rye when the soil is light and sandy. The cattle pull up a great deal and kill much by walking over it.

5th. That from this experience I am convinced that much better results would have been obtained by drilling one foot apart instead of two.

6th. This feed produced a good flow of milk and made the butter firm with an exceedingly rich color and flavor, and was a great relish to both horses and cows.

1. **SOFT MARL PHOSPHATE AS A FERTILIZER.**
2. **COMPARATIVE VALUE OF RAW FINELY POWDERED PHOSPHATE AND OF SUPERPHOSPHATE AS A FERTILIZER.**
3. **A SUPERPHOSPHATE FROM A LOW GRADE ROCK CONTAINING MUCH ALUMINA.**
4. **MUCK: COMPOSITION AND UTILIZATION OF.**

BY J. M. PICKEL.—ANALYSES BY J. J. EARLE.

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1. SOFT MARL PHOSPHATE AS A FERTILIZER.

We receive frequent inquiries as to the value of raw (unacidulated) phosphate rock as a fertilizer. As there is evidently much confusion and obscurity of thought on this subject, we cannot, perhaps, do better than give one of these letters and subjoin such information on the points of inquiry as is at hand:

"I mail you to day a package of soft marl phosphate, dried and partially ground, which is what I want analyzed, as it is in the shape we intend putting it on the market, but ground much finer. The other sample was just as it came from the ground, *green*. You cannot do the people of Florida a greater service, or one that will be more appreciated, than by giving us a full and complete analysis, showing everything this material contains, in exact proportions, what percentage is soluble *now*, exposed to sun and rain, in the ground, when the present insoluble part will become soluble, what foreign matter is required to make a complete fertilizer, cost, etc., of same, the real value of this material *ground fine* as compared with commercial fertilizers—say Mapes' at $43 per ton—and the best way of preparing it cheaply. The purchase of costly commercial fertilizers is the curse of the State, and with the raw material at our doors we ought to make it available. We want to know just what this soft marl phosphate, when *calcined and ground to an impalpable powder*, is worth to the farmer and fruit grower."

The questions asked here, with such answers as we are able to give, are as follows:

1. What is this substance composed of? It is composed of

Water	9.62
Sand and insoluble matter	24.42
Alumina	17.14
Ferric oxide	0.50
Calcium carbonate	2.50
Tri-calcium phosphate	43.55
Aluminium phosphate	1.97
	100.00

2. What percentage is soluble now, exposed to sun and rain?

This has reference to the percentage of phosphate now soluble. This is a question which cannot be answered with precision. The finer the rock is pulverized the faster will it become disintegrated and the more quickly will it become available as plant food. The action of the air, rain, soil, etc., are never ceasing. And to this is added the dissolving and assimilating power which the rootlets of plants themselves undoubtedly possess. Hence in the course of time the phosphate will all be taken up by the plants. Less than one-half of one per cent. of the phosphoric acid in this rock is soluble, according to the conventional method of determining solubility, in pure distilled water; and a fraction over 0.89 per cent. is what is conventionally called available.

All phosphates in their natural form are difficultly and slowly soluble in water or weak acids. Phosphates from different sources differ greatly in the degree of solubility. The following quoted from Storer will show this:

"Dietrich and Koenig acted upon various phosphates with carbonic acid water applied in such manner that the materials were soaked in a half saturated solution of it for forty eight hours, and the residue from this treatment was digested in saturated carbonic acid water for twelve weeks." The results were as follows:

MATERIAL.	Per cent. of phosphoric acid in the material.	After 48 hours' action of half saturated carbonic acid water, one part of phosphoric acid dissolved in parts of the liquid.	After 12 weeks with saturated carbonic acid water, one part of phosphoric acid dissolved in parts of the liquid.
Estramadura phosphorite.	37.20	90,900	90,900
Lahn phosphorite	14.80	60,100	60,100
Peruvian Guano	13.70	2,440	1,230
Raw Bonemeal	16.63	18,800	5.980
Stearns' Bonemeal	21.79	21,100	5,630
Bone ash	37.57	25,250	7,350

It will thus be seen that from about 1,000 to 90,000 parts of the carbonic acid water are necessary to dissolve *one* part of phosphoric acid.

This difference of solubility is due to many things—difference in physical aggregation (whether compact or porous, fine or coarse grained), the materials with which the phosphate is mixed or associated, the *kind* of phosphate (phosphates of lime, magnesium, iron and aluminium all differing in solubility). The Estramadura and the Lahn phosphorites are *mineral* phosphates and much less soluble than the guano and bone phosphate. Voelcker found that one part of pure freshly prepared and still moist tricalcium phosphate dissolves in 12,610 parts of water; whereas, one part of similarly prepared magnesium phosphate requires only 4,900 parts of water. Phosphate of iron is less soluble than phosphate of lime, and phosphate of alumina less than either. Warington has found that one part of pure phosphate of lime requires 1,785 parts of carbonic acid water to dissolve it; Pierre found that 12,500 parts of carbonic acid water are required to dissolve one part of phosphate of iron. Carbonic acid water is water saturated with carbonic acid gas; such water bears resemblance to rain water, which always contains carbonic acid absorbed from the atmosphere. It will thus be seen that phosphate in its natural state is exceedingly slowly soluble and available as a plant food. Superphospate, that is, phosphate which has been dissolved with acid, is easily and quickly soluble in water and is immediately available to the plant.

Tests of the solubility of all the leading varieties of Florida phosphate are to be made in our laboratory at the earliest opportunity.

3. When will the present insoluble part become soluble?

The answer to this question is implied in what is said under 2. The action of rain, air, soil, heat, etc., is constantly but exceedingly slowly dissolving the phosphate, which as it becomes soluble may be taken up by the plant. This solvent action may be, and often is, so slow that the plant may not be able to get enough phosphate, and the result is stunted growth.

4. What foreign matter is required to make a complete fertilizer of this material?

Before this question can be answered we must answer another: "What is a complete fertilizer?" In a broad and general way we may define a *complete fertilizer* as one which contains all of the chemical elements necessary to plant growth, each element in sufficient quantity and in a sufficiently soluble condition to meet the demands of the plant. To be economical, no element should be present in excess of the needs of the plant. It is generally accepted as settled that the elements necessary to plant growth are oxygen, hydrogen, carbon, phosphorus, nitrogen, potassium, calcium, magnesium, iron, sulphur. If a single one of these elements is lacking the plant will not grow. Chlorine, sodium, and silicon are always found in plants; but the weight of evidence seems to be that, although they may be of advantage in some cases, they are not necessary. Other elements still, among them manganese and aluminium, are sometimes found in plants. These elements are, of course, not offered to the plant in the elemental form, but always as compounds; oxygen and hydrogen, as water mainly; carbon, phosphorus, nitrogen, potassium, calcium, magnesium, iron, sulphur in the form of salts, known as carbonates, phosphates, sulphates, nitrates, chlorides and other rarer compounds; carbon also in union with oxygen, as carbonic acid gas in the air, and nitrogen in union with hydrogen, as ammonia.

In preparing a fertilizer it is not necessary to direct one's attention to all these elements, for the reason that most of them are always abundantly present in the atmosphere and in the soil. Ville, the great French agriculturist, defines a *complete manure*, therefore, as one containing *nitrogenized matter*, *phosphate of lime*, *potassa*, and *lime*. With these four substances together, of course, with what is already in air and soil, it is always possible to produce fine crops, he claims. Accepting this as true (and it doubtless is true in all except rare cases), the "foreign" substances required to make a complete fertilizer of this material are, *nitrogenized matter* and *potassa*. Among the principal forms of nitrogenized matter are the various nitrates, sulphate of ammonia, muck, barnyard manure, urine, cottonseed meal, oil cake and in a word all refuse animal and vegetable substances. The sources of potash are numerous, kainit and ashes being among the most important.

As to the proportions in which potash, nitrogen and this marl phosphate should be mixed to make a complete fertilizer, no general rule can be given. If they were mixed in such proportions as to contain 12 to 15 per cent. of phosphoric acid, 2 to 4 per cent. of nitrogen and about the same quantity (2 to 4 per cent.) of potash, the result would not differ very widely from the common run of "complete commercial fertilizers," *except* in this: the commercial fertilizer usually contains about 10 per cent. of phosphoric acid easily and immediately soluble in water, whereas this mixture would contain none such. It should be borne in mind, however, that it is not well to compound a fertilizer by mixing an exceedingly difficultly soluble plant food, such as tricalcic phosphate, with exceedingly soluble ones, such as kainit and the nitrates. The insoluble phosphate had better be applied separately to the land in large quantities as a fine powder. This application should take place many months before the planting of the crop to be benefitted thereby, and the potash and nitrogen (if in easily soluble forms) applied as the crop is growing or at the time of planting.

Florida muck is, much of it, rich in nitrogen. The composting of raw finely ground phosphate with muck, and the application of this compost in large quantities where it can be cheaply made is to be recommended as an experiment likely to give good results. This compost would, of course, need to be supplemented by the application from time to time, as needed, of some form of potash. If the phosphate used in this compost contains considerable carbonate of lime, all the better.

5. What is the real value of this material *ground fine* as compared with commercial fertilizers, say Mapes' at $43?

Mapes' fertilizer, say his Fruit and Vine Manure, is a complete fertilizer, containing about 7 per cent. of *soluble*, 3 per cent. of *insoluble* phosphoric acid, 3 per cent of nitrogen, 12 per cent. of potash. It would probably be difficult to find a soil so sterile that it could not, by the judicious use of this or any other similar fertilizer, be made to produce good crops. On the other hand, no soil deficient in potash and nitrogen could, by the use of this material alone, be made to yield a crop at all. In other words, phosphate cannot take the place of other elements of plant food. It is, therefore, not pertinent to compare phosphate with a complete fertilizer.

2. COMPARATIVE VALUE OF RAW FINELY POWDERED PHOSPHATE AND OF ACIDULATED PHOSPHATE AS A FERTILIZER.

A most important question is this: "What is the value, as a fertilizer, of *raw finely powdered phosphate*, as compared with *superphosphate*?" By RAW FINELY *powdered phosphate* is meant either the *soft* or *hard rock phosphate* reduced to a fine powder, and by superphosphate is meant this powder treated with acid and the phosphate in it rendered easily soluble. As the result of a series of most carefully conducted experiments, Prof. Wagner, of Darmstadt, Germany, concludes that the phosphoric acid in coprolite powder possesses 9 per cent., that in bone meal, 10 per cent. of the value of that in superphosphate. The phosphate in coprolite powder and Florida rock is, from a chemical standpoint, practically the same.

The price of phosphoric acid varies from about 2 to about 8 cents a pound. In dissolved bone-black it costs about 8 cents a pound, in dissolved South Carolina rock about 6 cents, in raw finely powdered South Carolina rock about 2 to 3 cents. The Connecticut Experiment ment Station has made a series of valuable experiments with these forms of phosphoric acid. The report says: "That the the more expensive forms are also the ones most quickly available to plants may readily be admitted, but it is a question whether the cost prices stand always in direct relation to the agricultural value; that is, on land deficient in phosphates, will $5 per acre spent in buying dissolved bone-black, for instance, yield a greater or less return in the long run than the same money spent for South Carolina rock or other raw phosphates, seeing that more than twice as much phosphoric acid can be bought for the same money in some of the cheaper forms, as can be bought in dissolved bone-black?"

In carrying out experiments to answer this question, all the plots were supplied liberally with nitrogen and potash; some plots received no other fertilizer. The effect of equal money value of the following phosphates were compared on the other plots:

Plot A—42 cts. worth (32 lbs.) of dissolved bone-black containing 5.1 lbs. phosphoric acid.

Plot B—42 cts. worth (56 lbs.) of Grand Cayman's phosphate, containing 16.5 lbs. of phosphoric acid.

Plot C—No phosphate.

Plot D—42 cts. worth (67½lbs.) of Thomas-slag, containing 13.2 lbs. of phosphoric acid.

Plot E—42 cts. worth (70lbs.) ground S. C. phosphate rock, containing 17.5 lbs. of phosphoric acid.

Plot F—No phosphate.

Grand Cayman's phosphate is a phosphatic rock, containing considerable iron and alumina, from an island of that name. Thomas-slag is a phosphatic byproduct of the steel manufacture. These phosphates and the S. C. rock received no treatment except that of pulverizing. Dissolved bone-black is one of the best forms of soluble or superphosphates. The experiments extended over three years. No phosphates were used after the first year. Indian corn was grown each year. Putting the products of the plots which received no phosphate equal to 100, the results were as follows:

SEASON OF 1887.

	Sound ears.	Soft ears.	Stover.	Total crop.
No phosphate	100	100	100	100
Dissolved bone-black	144	67	102	111
Grand Cayman's phosphate	141	64	121	119
Thomas-slag	140	57	107	110
South Carolina rock	118	66	99	100

SEASON OF 1888.

	Sound ears.	Soft ears.	Stover.	Total crop.
No phosphate	100	100	100	100
Dissolved bone-black	111	77	112	106
Grand Cayman's phosphate	137	73	125	121
Thomas-slag	140	65	135	125
South Carolina rock	127	80	118	115

SEASON OF 1889.

	Sound and soft ears
No phosphate	100
Dissolved bone-black	100
Grand Cayman's phosphate	145
Thomas-slag	156
South Carolina rock	129

These results are stated as follows: 1887—"In that season and on that land $5.00 would have paid about equally well whether it was spent for dissolved bone-black, Grand Cayman's phosphate or Thomas-slag." "An equal money value of ground South Carolina rock produced less than half as much increase of sound ears as the other phosphates and no increase at all of stover."

1888—"South Carolina rock made considerably larger percentage increase than the year before, showing that it was slowly becoming available in the soil." "The seasons and the land being such as they were, $5.00, if invested in 1887 in Grand Cayman's phosphate or Thomas-slag, would have yielded, in 1887, as much income as if invested in dissolved bone black, and in 1888 would have yielded a much larger income." "Where dissolved bone-black was applied in 1887 there was not quite sufficient phosphoric acid left in the soil from this application to meet the requirements of the crop for 1888."

1889.—"The stover was so damaged by continuous wet weather and blight, that it was not thought worth while to weigh it." Hence only the ears remain for comparison. "The investment made in Thomas-slag, Grand Cayman's phosphate and South Carolina rock in 1887 was still paying considerable dividends in 1889, while the investment in dissolved bone-black had ceased to yield any returns whatever."

"*On this particular piece of land and in these three seasons*, Thomas-slag and Grand Cayman's phosphate have been more profitable than dissolved bone-black."

There is no reason, known to the writer, why it may not be safely assumed that Florida phosphates will act very similarly to South Carolina and Grand Cayman.

To sum the phosphate question up in a word, the matter stands about thus:

1. *For immediate and quick results the superphosphates are conceded to be the best as a general rule.*

2. *If equal sums of money are invested in finely ground raw phosphate and in superphosphate, the returns from the raw phosphates will in the long-run exceed, in many, if not all cases, the returns from superphosphates.*

3. *It must be borne in mind that the above are general statements. The soils and seasons are all important factors; and what is true of one soil and one season may not prove true of another soil and season.*

3. SUPERPHOSPHATE FROM A LOW GRADE ROCK CONTAINING MUCH ALUMINA.

We are often asked as to the practicability of converting low grade phosphates with high per cent. of iron or aluminium, by means of sulphuric acid, into superphosphate. Last winter a rock which analyzed,

Moisture	1.77	per cent.	
Insoluble matter	36.90	" "	
Phosphoric acid, total	21.49	" "	equivalent to
	46.91	" "	tricalcic phosphate.
Phosphoric acid soluble in water	0.15	" "	
Ferric oxide	0.44	" "	
Alumina	13.06	" "	
Lime	28.00	" "	

was finely pulverized and treated with sulphuric acid according to the following formula:

Four parts by weight of the powdered rock; three parts by weight of sulphuric acid, 1.5 specific gravity.

The acid was *chemically pure.* After mixing and standing two days it analyzed,

Moisture at 115° C	22.32	per cent.
Total phosphoric acid	12.50	" "
Phosphoric acid soluble in water	11.31	" "
Reverted phosphoric acid	0.11	" "
Citrate insoluble phosphoric acid	1.08	" "

Another but much larger portion treated according to the same formula analyzed, after standing 89 days,

Moisture at 115° C	18.10	per cent.
Total phosphoric acid	12.50	" "
Phosphoric acid soluble in water	7.56	" "
Reverted phosphoric acid	3.43	" "
Citrate insoluble phosphoric acid	1.80	" "

It will be observed that, when freshly made, the superphosphate contained 11.31 per cent. of phosphoric acid soluble in water and only

0.11 per cent. of *reverted*; but after standing three months (89 days), the water soluble had dropped to 7.56 per cent. and the *reverted* risen to 3.43 per cent.

By *reverted* phosphoric acid is understood acid which, having once been made easily soluble in water, has "reverted," or gone back, to a form no longer soluble in water (or rather no longer easily soluble in water). "Reversion" is due in part, so it is believed, to the presence of iron and aluminium; hence in part the objection to iron and aluminium in phosphate. Another objection to them is that they tend to render the superphosphate *sticky*, and thus prevent their readily drying out and becoming pulverulent. In this particular case the drying-out process was slow, and even to the last the goods was somewhat moist, not so much so, however, as to prevent the possibility of its being sacked and shipped.

In the commercial valuation of fertilizers, phosphoric acid soluble in water is estimated at about 8 cents a pound, reverted at 7½ cents, and the raw (or non-acidulated), as it occurs in finely ground rock, at 2 cents. At these rates, a ton of our superphosphate (three months old) is worth $18.70. The rock from which this superphosphate was made contained in round numbers 47 per cent. of phosphate. A 75 per cent. rock would have given a goods containing 18 to 20 per cent. of water-soluble phosphoric acid. Where there is long transportation and consequently much freight, it would be far better for the farmer to buy the high grade goods, thus avoiding the cost of transporting an unnecessarily large amount of useless dirt.

Our rock produced a superphosphate containing 7.56 per cent. water-soluble phosphoric acid. This is too low a percentage to permit its being used for compounding a complete fertilizer. The admixture of the necessary potash and nitrogen would produce a goods containing not more, perhaps, than 3 or 4 per cent. of water-soluble phosphoric acid.

As long as the high grade phosphates are abundant, the low grades can have only a local and limited use. There are, however, on the market "acid phosphates" or superphosphates of no higher grade than this one (7.56 per cent. of soluble phosphoric acid), but the farmer who buys them pays freight on too much useless matter.

4. MUCK.

In a previous bulletin (No. 7) a number of annalyses of muck from various parts of the State was given. Several additional analyses are subjoined here. Opinions, in this State, vary widely as to the value of muck. A sufficient explanation of this difference of opinion may be found in the widely varying character of muck. One muck will differ from another, not only as to the quantity of fertilizer constituents, but also as to physical condition, that is, stage or degree of disintegration and decomposition. A careful study of the analyses given in this bulletin will be of use. In the table, following, is given the maximum, minimum and average per cent. of nitrogen, phosphoric acid and potash in eight samples of muck from various parts of the State, and, by way of comparison, in twenty-one samples of barnyard manure (analyzed at the Massachusetts Agricultural Experiment Station).

Nitrogen is valued at about 8 cts. in hair, horn shavings and coarse fish-scrap; at 15 cts. a pound in cotton-seed meal; at 17 cts. in ammoniates and in dry, fine-ground fish, meat and blood; potash at about 4½ cts.; and phosphoric acid at 2 cts. in fine-ground phosphate rock and 8 cts. when soluble in water. Nitrogen is thus the most costly plant food pound per pound that the farmer has to buy. There are in Florida muck beds containing great quantities of nitrogen. Whether or not this nitrogen can be economically made available, and the best methods of making it available, are question-worthy of most careful study.

		MOISTURE.			ORGANIC MATTER.			ASH.			NITROGEN.			POTASH.			PHOSPHORIC ACID.			INSOLUBLE MATTER.		
	Analyses.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
Muck (wet)...............	8	88.95	11.22	49.45	68.15	10.74	30.39	68.90	0.31	20.16	2.88	0.44	1.11	0.77	0.004	0.14	0.24	0.01	0.10	56.68	.13	16.94
Barnyard manure (wet)..	21	......	......	69.77	......	......	21.87	......	......	8.36	0.67	0.26	0.41	0.88	0.130	0.40	0.75	0.13	0.28	......	......	6.94
Muck (dry)...............	8	......	......	......	87.88	19.10	68.39	80.90	2.81	31.60	4.00	0.85	2.63	0,90	0.03	0.17	0.37	0.07	0.20	66.55	1.17	25.18
Barnyard manure (dry)..	21	......	......	......	......	......	*72.31	......	......	*27.66	......	......	*1.85	......	......	*1.32	......	......	*0.92	......	......	*22.89

* Calculated from the wet.

Valuation per ton, reckoning Nitrogen at 10 cents a pound, Phosphoric Acid at 2 cents and Potash at 5 cents:

Barnyard manure, wet –	Maximum, $2.52	Minimum, $0.70	Average, $1.33
Muck, wet...............	" 5.82	" .89	" 2.40
Barnyard manure, dry	"	"	" 4.39
Muck, dry..............	" 8.07	" 2.18	" 5.51

ORGANIC MATTER.—The muck, after being freed of moisture, is burnt at a low red heat; the loss in weight is reckoned as *organic matter*.

ASH —The residue after burning is called the ash, but is in this case not a *true ash*, containing, as it does, the sand, mud, etc., mixed in with the muck.

Close inspection of this table and the analyses which follow below will reveal these facts, namely:

1. The muck contains a great deal more nitrogen and much less potash and phosphate than the barn-yard manure.

2. The muck contains comparatively much nitrogen but is deficient in potash and phosphate. Hence in the use of muck as a fertilizer, one should expect that it would need to be supplemented by potash and phosphate.

3. The quantity of moisture in the muck runs from about ten to about fifty per cent.; even after it has been taken from the ponds and thrown up in heaps to dry, it will still, as it is usually hauled to the fields, contans more than fifty per cent. of moisture as a general rule.

4. The quantity of nitrogen is not, as at first thought one might be inclined to suppose, always proportional to the quantity of organic matter; that is, it does not always follow that the greater the quantity of organic matter the greater will be the quantity of nitrogen.

Examples:	(*a*)	Organic matter	29.82	per cent.	Nitrogen	1.17	per cent.
	(*b*)	" "	96.96	"	"	1.16	"
	(*c*)	" "	19.10	"	"	0.85	"
	(*d*)	" "	77.98	"	"	0.94	"

Muck (*a*) and muck (*b*) contain practically the same quantity of nitrogen, but there is nearly three and one-half times as much organic matter in (*b*) as in (*a*).

5. Fifteen samples of our muck, when perfectly dry, contained between 56 and 97 per cent. of organic matter; twelve of the fifteen contained from two to four per cent. of nitrogen, three less than two per cent., and one less than one per cent. Five samples contained less than 55 per-cent. of organic matter, four of which contain between one and two per cent. of nitrogen and one less than one per cent.

As is well known, plants of different kinds and different parts of the same plant contain different amounts of plant food. In the perfectly dry state, pea vines for example contain about two per cent. of nitrogen; wheat straw only about one per cent. One would naturally expect that a muck if formed by the disintegration of the former would contain more nitrogen than if by that of the latter.

6. These considerations will in part explain the fact that most of our mucks which contain a high per cent. of organic matter in advanced stage of decomposition contain also a high per cent. (more than two per cent.) of nitrogen, and that

7. There are among our mucks several which, though containing a high per cent. of organic matter, seemingly far advanced in disintegration, nevertheless have a low percentage of nitrogen (less than two per cent.).

In judging of the value of a muck three things, at least, are to be taken into account: 1. The kind or kinds of plants from which formed. 2. The quantity of organic matter in the muck, and 3. The stage of decomposition.

As to the best methods of using muck, opinions differ somewhat. It should be remembered that in addition to its value as a fertilizer purely, is, what some regard as of more importance, its value as a mulch. As stated before, its content of potash and phosphate is generally too small to be of consequence; it is its nitrogen that gives it importance. The nitrogen, however, is in a very insoluble, inactive form; still there is little doubt that as the process of oxidation and decay goes on, much, if not all, of the nitrogen gradually and slowly becomes available; and it is not impossible that if a good quality of muck is spread upon a field in large quantity, it may furnish all the nitrogen needed. Whether or not this is an economical source of nitrogen depends, of course, among other things, on the labor and cost of placing it upon the field, and is to be determined for each farm for itself.

When it is desired to render the nitrogen speedily available, composting is resorted to. Just what takes place in the compost heap is only partially understood. This much, however, is known: a process of heating and fermentation takes place whereby the vegetable tissues are disintegrated and the insoluble nitrogen converted into soluble forms (nitrates and nitrites). The conditions favorable to this process are moisture, warmth (about 98° to 100° Fahrenheit), contact with oxygen of the air (hence the value of turning over the heap occasionally), exclusion of too much light. Substances whose presence in the compost heap favor the process are: all easily putrescible animal or vegetable matter (such as barn-yard manure, cottonseed meal, urine, the offal from slaughter houses, blood, flesh, fish-scrap); alkalies (potash, soda, lime); carbonate of lime (wood ashes. finely ground and unburnt oyster shells, marl, rotten limestone). Here in Florida the so-called soft phosphates or finely ground phosphates of any kind that contain a large per cent. of carbonate of lime, would seem specially to recommend themselves in this connection.

As to the proportion of muck that should be mixed with these substances, no fixed rule can be given, for the reason, among others, that muck is so variable in quality. Some use only so much vegetable or animal matter as is barely sufficient to bring about the complete fermentation of the muck; for example, one part of barn-yard manure to one, two, three, four or five parts of muck. In the case of the alkalies and carbonate of lime, too large a proportion prevents fermentation entirely. There are mucks that will of themselves, without addition of foreign matter, ferment if thrown up in heaps.

Twenty tons of well fermented barnyard manure per acre would not be regarded a large application; fifty or sixty tons per acre are sometimes applied on vegetable gardens near the large cities. Similarly, if full benefit of muck is to be reaped, it should be applied in large quantity.

In view of the large quantity and in many cases high quality of the muck in this State, the conditions most favorable to nitrification (conversion of the *insoluble* into soluble nitrogen) are worthy of careful and extended investigation, and it is hoped that experiments in this line can be undertaken at no very distant day.

TABLE SHOWING PERCENTAGE OF FFRTILIZER CONSTITUENTS IN WET AND DRY MUCK.

WET.

SAMPLE NUMBERS.	297	298	299	601	592	595	41	51	Average.
Water	84.30	59.57	88.95	11.22	22.45	85.15	29.13	14.83	49.45
Ash	2.25	22.90	0.31	38.90	9.40	3.00	15.60	68.90	20.16
Organic Matter	13.45	17.53	10.74	49.88	68.15	11.85	55.27	16.27	30.39
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	0.62	0.66	0.44	2.41	2.88	0.49	0.66	0.70	1.11
Insoluble Matter	0.86	19.91	0.13	35.52	7.94	2.51	8.86	56.68	16.49
Phosphoric Acid	0.06	0.11	0.01	0.07	0.10	0.01	0.22	0.24	0.10
Potash	0.01	0.02	0.004	0.02	0.02	0.005	0.13	0.77	0.14
Soda	0.02	0.03	0.014	0.13	0.05	0.014	0.75	1.68	0.33

DRY.

SAMPLE NUMBERS.	297	298	299	601	592	595	41	51	Average.
Water	......	......	......	......	......	......	......	......	....
Ash	14.33	56.64	2.81	43.82	12.12	20.21	22.02	80.90	31.60
Organic Matter	85.67	43.36	97.19	56.18	87.88	79.79	77.98	19.10	68.40
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	3.92	1.64	4.00	2.72	3.71	3.30	0.94	0.85	2.63
Insoluble Matter	5.49	49.24	1.17	39.99	10.24	16.93	11.80	66.55	25.18
Phosphoric Acid	0.37	0.28	0.07	0.08	0.13	0.07	0.31	0.28	0.20
Potash	0.06	0.05	0.04	0.03	0.08	0.08	0.18	0.90	0.17
Soda	0.15	0.07	0.13	0.15	0.06	0.09	1.06	1.97	0.46

293 and 294. MUCK.

Samples sent on by G. Jackson, Apopka, Fla. Mr. Jackson says of this muck that the bed is on the north side of Bear Lake, is three or four miles long, 200 feet wide and from one to four feet deep; that there are bays in the lake where the muck is much deeper; that they have drained the lake about three feet; that he has grown some very fine potatoes, cabbage, beans and onions on the muck, and that wherever he has applied it as a fertilizer it has made good growth.

Analysis.	293.		294.	
	(*a*)	(*b*)	(*a*)	(*b*)
Water	64.05		56 60	
Ash	1.05	2.92	3.45	7.95
Organic matter	34.90	97.08	39.95	92.05
Nitrogen	0.70	1.94	0.74	1.69
Equivalent to ammonia	0.85	2.36	0.89	2.05

(*a*) is the wet muck; (*b*) is the muck dried perfectly by artificial heat.

Valuation per ton: 293—wet $1.40, dry $3.88; 294—wet $1.48, dry $3 38. In this valuation nitrogen only is taken into account and at 10 cents a pound. This number is perhaps too large; 7 or 8 cents a pound would be more nearly correct.

295 and 296. Muck.

Samples of H. G. Hastings, Interlachen, Fla. No account of its source or use.

Analysis.	295.		296.	
	Wet.	*Dry*	*Wet.*	*Dry.*
Water	69.55		41.30	
Ash	3.75	12.31	21.70	63.03
Organic matter	26.70	87.69	37.00	36.97
Nitrogen	0.85	2.87	1.02	1.72
Equivalent to ammonia	1.06	3.49	1.23	2.09

Value per ton: 295,—wet $1.70, dry $5.74; 296—wet $2.04, dry $3.44.

297. Muck.

Samples of David McClardy, Lake Worth, Fla. Bed 40 acres in extent, situated at the north end of little Lake Worth, one mile from ocean beach.

Analysis.	*Wet.*	*Dry.*
Water	84.30	
Ash	2.25	14.33
Organic matter	13 45	85.67
	100.00	100.00
Nitrogen	0.62	3.92
Equivalent to ammonia	0.75	4 74

A partial analysis of the ash of this muck to ascertain the per cent. of potash and phosphoric acid gave:

Sand and insoluble matter	38.27
Phosphoric acid	2.57
Potash	.40
Soda	1.04

A ton of this muck contains, wet, 45 pounds of ash, 1.16 pounds of phosphoric acid and .18 pounds of potash; dry, 286.6 pounds of ash, 7.36 pounds of phosphoric acid, 1.15 pounds of potash.

Value per ton:

	Wet.			Dry.		
Nitrogen	12.4 lbs.	at 10c.	$1.24	78.4 lbs.	at 10c.	$7.84
Phosphoric acid	1.16 lbs.	at 2c.	.02	7.36 lbs.	at 2c.	.14
Potash	0.18 lb.	at 5c.	.01	1.15 lbs.	at 5c.	.05
			$1 27			$8.03

298. MUCK.

Sample of C. D. Wood, Archer, Fla. Mr. Wood says of this muck: "It was taken from a muck bed situated in a dense hammock and surrounded by hard-wood trees of a large size. It covers about five acres and is from three to five feet deep. It is covered with water during the wet season but entirely dry now (May 8, '91). When taken out it pulverizes readily and mixes with the soil. I have been using it around orange trees for three years with excellent results as far as producing a good healthy growth and giving to the tree a dark green color. But I am inclined to believe there is some element lacking for fruit making, as the large trees, when I use it and nothing else, do not bear well."

The element or elements lacking in this, as in almost all muck, are phosphoric acid and potash.

Analysis.	*Wet.*	*Dry.*
Water	59.57	
Ash	22.90	56.64
Organic matter	17.53	43.36
	100.00	100.00
Nitrogen	0.66	1.64
Equivalent to ammonia	0.81	1.99
The ash contains:		
Sand and insoluble matter		86.93
Phosphoric acid		0.50
Potash		0.08
Soda		0.12

The quantity of fertilizer elements in a ton of this muck, with their value, is:

	Wet.			Dry.		
Nitrogen	13.2 lbs.	at 10c.,	$1.32.	32.8 lbs.	at 10c.,	$3.28
Phosphoric acid	2.29 lbs.	at 2c.,	0.04.	5.7 lbs.	at 2c.,	0.11
Potash	0.37 lb.	at 5c.,	0.02.	0.9 lb.	at 5c.,	0.05
Total value per ton			$1.38			$3.44

299. MUCK.

Sample of J. R. Hurst, Lake Helen, Fla. No account of its occurrence or use.

Analysis.	*Wet.*		*Dry.*	
Water	88.95	per cent.		
Ash	0.31	"	2.81	per cent.
Organic matter . . .	10.74	"	97.19	"
	100.00	"	100.00	"
Nitrogen	0.44	"	4.00	"
Equivalent to ammonia	0.54	"	4.84	"

The ash contains

Sand and insoluble matter	41.66	per cent.
Phosphoric acid	2.50	"
Potash	1.32	"
Soda	4.62	"

The quantity of fertilizer ingredients in a ton and their value is:

		Wet.		*Dry.*	
Nitrogen	at 10 cents,	8.8 lbs.,	$0.88;	80.0 lbs.,	$8.00
Phosphoric acid	at 2 cents,	0.15 lbs.,	.003;	1.4 lbs.,	0.03
Potash	at 5 cents,	0.08 lbs.,	0.004;	0.7 lb.,	0.04
			$0.89		$8.07

591. Muck.

Sample by C. W. Brown, Huntington, Fla. Mr. Brown says of this muck: "It is in a grass pond of some eight or ten acres, is covered with two feet of water and about the same of common muck and grass roots. The depth of the deposit is unknown, have only dug on the edge of pond to any extent, have used it on grove, spreading it broadcast and then penning cattle on it. The result is the grove is the best looking one in this section. People wonder why it has come on so well."

Analysis.	*Wet.*		*Dry.*	
Water	10.40	per cent.		
Ash	62.88	"	70.18	per cent.
Organic matter . . .	26.72	"	29.82	"
	100.00	"	100.00	"
Nitrogen	1.05	"	1.17	"
Equivalent to ammonia	1.72	"	1.42	"

Value per ton, nitrogen, at 10 cents, 11 lbs., $1.10; 23.4 lbs., $2.34.

601. Sample of G. T. Lawler, Hudson, Fla.

Mr. Lawler says: "The pond covers 8 or 10 acres and the muck is in great masses like islands and is from two to four feet in thickness. The bottom of the pond also seems to be covered with it. In the rainy season, when the water gets high, it floats ashore and is left there when the water goes down. It is strange that, although there are numerous ponds around here, mine is the only one that has any muck in it. I have used it on my orange grove (a small one of five acres) and I find it very good. I spread it in a circle around the trees. I have used no other fertilizer but the leaves and grass from the woods about my place, and I do not know of any trees of their age that can approach mine in size and thrift. About three years ago some small boys killed a young alligator near the pond and I buried it in the muck pile; about three weeks after that I went down to get some muck and dug into the place where it was buried and found only the bones bleached as white as chalk. * . * It also draws the skin on the hands if you handle it. The soil in my grove is sandy, but is underlaid with clay, or what we call clay for want of a better name. It is a bright yellow color and when fresh dug has the smooth soapy feel of clay, but when it dries it crumbles to a sandy powder. It seems to be good for trees, for my best trees are where it is nearest the surface."

This muck was neither acid or alkaline in reaction.

Analysis.	*Wet.*	*Dry.*
Water	11.22 per cent.	00.00 per cent.
Ash	38.90 “ “	43.82 “ “
Organic matter	49.88 “ “	56.18 “ “
	100.00	100.00 “ “
Nitrogen	2.41 “ “	2.72 “ “
Equivalent to ammonia	2.93 “ “	3.30 “ “

The ash contains—

Sand and insoluble matter	91.30
Phosphoric acid	0.19
Potash	0.06
Soda	0.34

The quantity of fertilizer constituents in a ton and their value are—

	Wet.		*Dry.*	
Nitrogen at 10 cts	48.2 lbs.	$4.82	54.4 lbs.	$5.44
Phosphoric acid at 2 cts	1.4 “	.028	1.6 “	.03
Potash at 5 cts	0.4 “	.020	0.6 “	.03
Total valuation per ton		$4.87		$5.50

592. MUCK.

Analysis.	*Wet.*	*Dry.*
Water	22.45 per cent.	0.00 per cent.
Ash	9.40 “ “	12 12 “ “
Organic matter	68 15 “ “	87.88 “ “
	100.00 “ “	100.00 “ “
Nitrogen	2.88 “ “	3.71 “ “
Equivalent to ammonia	3.51 “ “	4.52 “ “

The ash contains—

Insoluble matter	84.48 per cent.
Phosphoric acid	1.10 “ “
Potash	0.25 “ “
Soda	0.53 “ “

The fertilizer constituents in a ton and their value are—

	Wet.		*Dry.*	
Nitrogen at 10 cts	57.6 lbs.	$5.76	74.2 lbs.	$7.42
Phosphoric acid at 2 cts	2.0 "	.04	2.6 "	0.05
Potash at 5 cts	.4 "	.02	.6 "	.03
Total valuation per ton		$5.82		$7.50

41. Muck (salt or tide-water muck).

Analysis.	*Wet.*	*Dry.*
Water	29.13 per cent.	0.00 per cent.
Ash	15.60 " "	22.02 " "
Organic matter	55.27 " "	77.98 " "
	100.00 " "	100.00 " "
Nitrogen	0.66 " "	0.94 " "

The fertilizer constituents and their value are—

	Wet.		*Dry.*	
Nitrogen at 10 cts	13.2 lbs.	$1.32	18.8 lbs.	$1.88
Phosphoric acid at 2 cts	4.4 "	.09	6.1 "	.12
Potash at 5 cts	2.6 "	.13	3.6 "	.18
Total valuation per ton		$1.54		$2.18

51. Muck.

From a river island; to be regarded rather as river mud than muck.

Analysis.	*Wet.*	*Dry.*
Water	14.83 per cent.	00.00 per cent.
Ash	68.90 " "	80.90 " "
Organic matter	16.27 " "	19.10 " "
	100.00	100.00
Nitrogen	0.70	0.85

The fertilizer constituents in a ton and their valuation are—

	Wet.		*Dry.*	
Nitrogen at 10 cts	14.0 lbs.	$1.40	17.0 lbs.	$1.70
Phosphoric acid at 2 cts.	4.8 "	.10	5.6 "	.11
Potash at 5 cts	15.4 "	.77	18.0 "	.90
Total valuation per ton		$2.27		$2.71

595. Muck.

Samples from a saw-grass pond.

Analysis.	*Wet.*	*Dry.*
Water	85.15 per cent.	00.00 per cent.
Ash	3.00 " "	20.21 " "
Organic matter	11.85 " "	79.79 " "
	100.00 " "	100.00 " "
Nitrogen	0.49 " "	3.30 " "

The fertilizer constituents in a ton and their valuation are—

	Wet.		*Dry.*	
Nitrogen at 10 cts	9.8 lbs.	$0.98	66.0 lbs.	$6.60
Phosphoric acid at 2 cts	0.2 "	0.004	1.4 "	.03
Potash at 5 cts	0.1 "	.005	0.6 "	.03
Total valuation per ton		$0.99		$6.66

602. MUCK.

Sample from a pond situated on high pine land near Barberville, Volusia county.

Analysis.	*Wet.*		*Dry.*	
Water	15.75	per cent.	00.00	per cent.
Ash	34.70	" "	41.19	" "
Organic matter	49.55	" "	58.81	" "
	100.00		100.00	
Nitrogen	2.06	" "	2.45	" "
Valuation per ton (nitrogen alone)	$4.12		$4.90	

604. MUCK.

Sample of J. D. Green, Sea Side, Fla.

Analysis.	*Wet.*		*Dry.*	
Water	30.42	per cent.	00.00	per cent.
Ash	42.11	" "	60.52	" "
Organic matter	27.47	" "	39.48	" "
	100.00	" "	100.00	" "
Nitrogen	0.47	" "	0.67	" "
Valuation per ton (nitrogen alone)	$0.94		$1.34	

600. BAT GUANO (sent by H. L. Reed, Macclenny, Fla.).

Moisture	16.90 per cent.
Ash	7.45 per cent.
Organic matter	75.65 per cent.
	100.00 per cent.
Nitrogen	11.34 per cent.
Phosphoric acid	2.67 per cent.
Potash	1.08 per cent.

Valuation per ton,

Nitrogen at 10 cents; 223.8 pounds	$22.38
Phosphoric acid at 2 cents; 53 4 pounds	1.07
Potash at 5 cents; 21.6 pounds	1.08
	$24.53

289. RICE HULLS (sent by J. E. Cole, Glen St. Mary, Fla.).

Mr. Cole desired to know their probable value as cattle food.

Moisture	12.58 per cent.
Ash	11.60 per cent.
Crude fat	5.88 per cent.
Crude fiber	20.58 per cent.
Crude protein	7.25 per cent.
Nitrogen free extract	42.00 per cent.
	100.00
True albuminoids	7.00 per cent.

The indications are that this is an excellent cattle food. These hulls contained a considerable quantity of broken grains of rice.

Bulletins mailed free to any farmer or fruit grower on application.

Any Sub-Alliance in the State can receive bulletins by forwarding names, either on postal cards or by letter, to

JAS. P. DEPASS, DIRECTOR,
Lake City, Florida.

BULLETIN No. 14,

—OF THE—

EXPERIMENT STATION

OF FLORIDA,

—AT THE—

STATE AGRICULTURAL COLLEGE,

Lake City, Florida.

ANNUAL REPORT—HORTICULTURE, CEREALS, STOCK, ETC.

JULY 1, 1891.

REV. JAS. P. DEPASS, DIRECTOR.

JACKSONVILLE, FLORIDA:
DACOSTA PRINTING AND PUBLISHING HOUSE.
1891.

ANNUAL REPORT.

Gentlemen of the Board:

I have the honor to submit the following as my annual report:

The land which was cut down and only in part ridden of stumps at your last meeting, has been put in condition, and now every foot of it is in cultivation. I have found it necessary to rent about fifty acres additional land, not only for experiments, but in order to assist in feeding the stock of the Station. The experience of this and the past year demonstrates that I have endeavored to make too wide a range of experimentation with the limited scientific help I have had at command. It will be necessary, therefore, to confine myself to fewer experiments in the future, unless the assistance necessary to carry on the work be furnished. It is found by this year's experience that so great is the demand in each department for scientific investigation that it is impossible for one man to meet the duties of two or more, as has been the case since the Station was established.

The Station land is uniformly sandy, thirsty and poor, and in some places almost sterile. That recently cleared produces well, but, unless it is kept up by liberal fertilizing, in two or three years its fertility will have passed away. It is a matter of regret that I do not possess a greater variety of soil to experiment on. In calling your attention to this matter, it is in the hope that you will aid me in this direction to the extent of your power. It certainly can only be a matter of time when the demands of our varied climate and soils will call for a wider range of experimentation to meet their conditions than are furnished on the Station.

It has been my plan not to fertilize extravagantly except in a few instances, and then only to a limited extent, testing the capacity of the soil to respond to heavy fertilizing, but moderately, watching the results with care, in order to encourage our people in those methods which would result in prosperity to them.

While experiments in those crops which constitute the common farming of our State have received special attention, still I have not neglected to introduce anything new which gave promise of success which I could command, in order to increase our agricultural resources. In this line of effort I take great pleasure in acknowledging the assistance of the Department of Agriculture at Washington, the officers of which have not only readily responded to every request, but in many instances have anticipated our needs. In this connection I wish also to acknowledge a package of seeds of many varieties of deciduous fruits which I have recently received from China through the kindness of the Rev. Dr. Young J. Allen, President of the Anglo-Chinese College and a distinguished missionary, whose residence is at Shanghai.

When I took charge of the Station, the low prices of black and white seed-cotton, our leading agricultural products, together with the scarcity of labor and its increasing high prices, led me to forecast the time as near at hand when our people would be forced to either reduce the area of these crops or abandon them altogether for others that are more lucrative. In view of these facts and the adaptability of our State to the growth of rare and luscious fruits, the production of vegetables, and the finer grades of tobacco, I was induced to give special attention to experiments in these lines. Already the area of black seed cotton from these causes have been reduced twenty-five if not thirty-three per cent. this year, and the indications are that another year a still larger reduction will be made.

The orange, which is now almost entirely confined to South Florida, I have reason to believe, so far, at least, as the Satsuma is concerned, can be grown profitably in the northern and western counties of our State, and possibly other popular varieties. Laboring under this conviction, I have made some experiments which are encouraging, and have some plans to propose, which I will at the proper time submit for your action.

It affords me pleasure to state that the chemists have promptly responded, as far as possible, to every demand upon them, working with unremitting care to render the Station of practical value to the people. The information furnished through this department, if utilized, would be of great service in advancing our agricultural interests.

This department has been embarrassed by urgent applications for analyses outside of the regular work of the Station. The public seems impressed that it is my duty to have analyzed any and everything sent me, and while, if I had the chemical force, I would cheerfully comply with these requests, still the necessities of the case have forced me to reluctantly decline a great many urgent applications.

The Station has reached that stage when it is necessary to have two more chemists, if the range of investigations is pursued designed by the law, and also if the pressing necessities of progressive agriculture are met. And I would here also suggest the election of a Horticulturist, as this department requires unremitting attention.

The scientific positions in connection with the Station are such as to require constant study and research, and unless the Director and his staff have more time for this than their pressing duties will now allow, they will not be able to keep abreast with agricultural science. The inadequate force now employed, in view of the work required, renders it impossible to pursue that range of investigation so necessary to meet the wants of our people.

The sub-Stations, one located in the western portion of the State at DeFuniak, under the superintendence of L. W. Plank, and the other in the southern portion of the State at Ft. Myers, in charge of Dr. L. C. Washburn, have no special reports to refer to your consideration. The work done on these stations the past year has been mainly that of land preparation, still each have made commendable efforts to a limited extent on some lines of experimentation, such as fruits, vegetables, cereals, forage plants and other things.

In view of the pressing demands made upon the Station for scientific work and the embarrassment of the fund by the maintenance of the sub-Stations, thus preventing the employment of scientific help in a measure, it becomes my duty to recommend to the Board their discontinuance. At most they can never be otherwise than simply trial points to test the adaptability of new fruits, plants and methods of cropping mostly beneficial to the communities in which they are located. This involves cost to an extent which the fund at the disposal of the Board will not admit of, provided it carries out the design of the law, besides also the benefits to the people at large is inadequate to the outlay. They require also a class of men who cannot afford to devote their entire attention to this work, which the present conditions require for the salary paid, besides the facilities for distributing what information they may acquire are too limited to accomplish much good. They are too remote from the station for the Director to visit them as often as he should, which from the nature of the case is a necessity; besides the time required and the expense attending such visits and their support could be more profitably employed in the interest of general agriculture. Experiments such as are conducted on them could be made in different counties of the State, through the medium of intelligent and progressive farmers and fruit-growers, of such crops and fruits adapted to each section, the Station furnishing free the necessary fertilizer, giving results to the farmer. This wider range of experimentation would not only be less than half their present cost, but a corresponding result would be obtained in interesting more farmers and fruit growers in improved methods of horticulture and general farming than the present one, and this, as now, could be done under the suggestions of the Director, to whom reports could be made and by him published. Out of these sub-Stations there will always be questions arising of an embarrassing nature; besides to keep them supplied by proper men in their constant stages of development is a problem not easily solved. The present necessity of the Station for the employment of scientific men could be more easily met if the fund was relieved of their support and their employment would more largely benefit the sections in which they are located, if not the immediate neighborhoods, in connection with the plan suggested above. This seems to be the prevailing opinion in other States where sub-Stations have been tried, unless they have been liberally sustained by State aid, which has given them scientific help. This State, however, has never contributed a cent to the Experiment Station, and the support of sub-Stations from the fund appropriated by the general Government will always be an embarrassing problem as long as they are continued.

BULLETINS.

Applications for the bulletins of the Station are constant. Every new publication increases the list of names, and requests for back numbers are frequently made. To meet the demand I have issued 7,500 copies of the April Bulletin No. 13. Besides this another encouragement is the many letters received appreciating the work the Station is doing, and another is the desire expressed by some to have the bulletins bound for permanent use.

Letters of inquiry are frequent on almost every branch of horticulture and general farming, some of which require a good deal of time to answer.

In addition to this there are many letters of inquiry as to Florida's resources, the prices of lands and the prospect of new industries. To comply with these requests not only requires time, but the want of available literature is quite embarrassing. I have tried to devise plans to meet these inquiries, and see no other way than to have printed articles on various subjects and have them ready for distribution. This not only involves expense but time in their preparation. However, to meet this emergency, I have solicted articles from prominent and reliable gentlemen throughout the State, who have devoted much time to special pursuits, but these, with one or two exceptions, like myself, are too busily engaged to devote the time to their preparation which they require.

HORTICULTURE.

THE PEACH.*

The great drawback to the northern tier of counties of East and Middle Florida, in cultivating the peach and plum, is the curculio. This beautiful portion of our State, if rid of these, would become famous for these fruits. In West Florida I have heard but little of them. The people of these sections should grow these fruits for the home, if for no other purpose. In Milton I learn that a canning factory has been built. This is the right kind of progress because the factory was established before the fruit and vegetables were planted in such quantities as were needed—it encouraged planting. Fruit and vegetable growing in Santa Rosa will follow as a necessary consequence. No less than an acre should be set for a home orchard and four would be much better. A proper selection from early to late peaches; say from May to October would give the family this delicious and healthy fruit for six months in the year. If care should be taken to prevent the curculio for two or three years they would soon disappear or be so reduced in numbers as to do but little injury.

The varieties of early peaches adapted to the various sections are as follows:

For South Florida, the Peento and its sports, among which are the Bidwell Early and Bidwell Late, Barr's Early and Barr's Late, the Queen of the South, Cream, Yum-Yum, Florida's Own, Waldo, Angel and Honey. There are other varieties of the Peento, doubtless equally as good but not so well known. The noyau or bitter almond flavor of the Peento is more marked when ripening in dry weather and on poorly fertilized land. Of all our early varieties the Peento is the daintiest when grown under favorable circumstances, and a few trees are worth the trouble and expense of protection in any part of the State. North and West of Marion county the cold snaps of spring render the crops too uncertain to be planted for shipping on account of its early blooming This is also true of its sports except the Waldo which blooms in February. The Waldo is a clearstone and thus far the best peach as an early variety for East and Middle Florida. It ripens almost as early as the Peento does south and is of excellent flavor. As a shipper it is the best. I have tested its keeping qualities by carrying several in my valise when ripe for two weeks, and after traveling hundreds of miles they were firm, with no evidence of decay.

The Dwarf Japan Blood ripened this year on the Station. This is a freestone, large medium size but ordinary as to flavor. It is possible it may prove a better peach when the trees are older. It blooms in February, is showy and as a shipper may prove valuable. It is worthy of trial.

PEARS.

There are two kinds of pears fruiting this year, the LeConte and another, the name of which is unknown. The LeConte has fruited for several years but very lightly. This year the trees were fertilized and cultivated the same as the peaches, and the crop was so large as to compel the thinning of fruit to save them. The unknown also bore heavily, having fruited last year for the first time, and from time to time the limbs had to be relieved of their fruit to save them from breaking down. The unknown is a very late pear.

I have budded eleven other varieties on LeConte stock which are growing very fast and which will be carefully watched to note their adaptation to our climate.

JAPAN OR ORIENTAL PLUMS.

Of these I have nine varieties growing. The Kelsey fruited this year and is an exceedingly large and choice variety. It is a heavy bearer and ought to be on every farm and garden in the State that will produce them, if for no other purpose than for family use. The others have not as yet fruited, but have in some other sections of the State, and are highly spoken of.

FERTILIZING THE PEACH, PLUM AND PEAR.

Mistakes are made in using the wrong kinds, too much and too little fertilizer. Different soils require different grades and every man must be the intelligent judge of his own soil. For instance, first class pine land ought not to be fertilized as heavily as lower grades, nor new lands as old lands. But there is no land that is cultivated awhile in Florida but what should be fertilized to a greater or less extent for all crops that are planted upon them, and this is especially true of the peach, pear and plum.

One has but to ride through the country and he will be struck by this fact, that the trees nearest the dwelling are the thriftiest, the healthiest and the most fruitful, while those that are farther away are not so good. Indeed, the farther the trees extend from the dwelling the poorer and less productive they are. This is because the trees nearest the houses are fertilized every day in the year, more or less, by means of what is naturally the waste of the house and kitchen, the droppings of chickens and in many other ways. This alone teaches the necessity of fertilizing.

Nitrogen, Phosphate and Potash are the main elements of a complete fertilizer.

How to obtain these in their cheapest form is a question of much importance. The nitrogen supply is obtained mainly from nitrate of soda, dried blood, cottonseed meal, cottonseed, horse and cow manure, pea vines and muck. The quantity in muck depends mostly upon its state of decomposition and the vegetable matter which composes it. Its cheapness depends upon the cost of gathering and hauling it. To be made most available it should be composted with other things. To use it alone large quantities and air exposure are a necessity.

Cottonseed meal is the best and cheapest source of our commercial supply, because it is not so readily available and not so quickly leached by the rains in winter and early spring in our light sandy soil.

Potash is obtainable from sulphate of potash, kainit, ashes and other commercial manures. Of these I prefer kainit, because while it contains about 23.90 per cent. of sulphate of potash, corresponding with 12.80 pure potash, it has about 34 per cent. of salt—the chloride of sodium. This, aside from attracting moisture, does to some extent serve as a protection against injurious insects.

Phosphate is mostly used in the acidulated form, called acid phosphate, because it is more available as plant food in this form. The phosphates of Florida will readily and cheaply meet this demand. The soft phosphate, if dried and powdered or ground fine, will be available. But it is not so easily available as when treated with acid. I have tried the Charleston "Floats," which is rock ground very fine and not treated with acid. The first year results are not so perceptible, but they are better the second, and if the supply is kept up from year to year there is no doubt but what this is the cheapest and best form of applying it. This is doubtless true of soft Florida phosphate. Those interested in the use of phosphate are referred to Bulletin 13. It may not be out of place to caution purchasers against buying Florida phosphate as a *complete fertilizer*. Should any be advertised as such, it would be wise before purchasing largely to buy a small lot, demand formula and send sample to State Chemist for analysis and opinion. Phosphate used alone is not apt to produce the results desired. On some of our lands it may be all that is required to produce good crops, but it is not safe to rely on it.

In our light soils lime and iron are needed. These are not by some classed as fertilizers but stimulants, still they are necessary in order to have healthy and fruitful trees. It is thought also that all land possesses enough of these to meet the demands of plant life, but their application, especially on old land, is too manifestly beneficial to neglect their use, at least in limited quantities. I have found, especially on old land, fine results to follow their use in the form of copperas or sulphate of iron and common lime. The Station orchard, which is planted on very old land, has received very great benefit from their application, and so has my private orchard, where their value was tested years ago, and reports published in the press of the State. The following formula was used on the Station orchard with fine effect:

STATION COMPOST NO. 1.

2,000 lbs. stable manure.
333 lbs. kainit.
333 lbs. acid phosphate.
333 lbs. cottonseed meal.

This was composted in a covered pen several months before used and constituted one layer in a pen ten feet square. It was made thoroughly wet and another layer put on and wetted, and so on until the pen was full, when three or four inches of dry dirt covered the top of heap. In breaking the pen this is thoroughly mixed and from 10 to 25 pounds scattered around each tree. When putting this out I added one pound each of copperas and lime to each tree.

The following formula may suit some localities where the soil is better than that of the Station:

2,600 pounds stable or cow manure or pond muck.
100 pounds copperas.
100 pounds kainit.
100 pounds cottonseed meal.
100 pounds acid phosphate.

The three last ingredients ought to be mixed before composting. It is cheaper and better mixed by the party from whom it is bought. When copperas is used, scatter it after compost is applied and expose it to air for some time.

DISEASES.

The pear in some portions of the State has developed the blight which is very destructive. It is a matter of congratulation that thus far this disease is only confined to certain localities, yet in time it may become general. It is sometimes first noticed by the tops of limbs dying back. Again while the leaves and limbs and even the entire tree presents a healthy foliage, the bark around the body or limb, or partly around, becomes hard and dry, when upon being cut into, shows the lining to be red, which in time becomes black and adheres to the body of the tree. This extends sometimes evenly and again in spots, but spreads until the disease accomplishes its work of destruction. Various opinions obtain as to the origin of this disease, but thus far nothing definitely has been settled, and hence the treatment is but a matter of experiment. The pear trees of the Station are not diseased, but the past two years have fruited lightly. This season they were loaded down with fruit, the limbs having been in part relieved to prevent them from breaking down. They were fertilized and cultivated as the peach and plum, and like them have made a fine growth. The plum thus far has not been assailed with any enemies except the

Grapes for shipping and table use, however, appear to take the lead, and the prices reported through the press represent them as being very profitable.

APPLES.

The apple in Florida has not proven a success. In Jefferson county the crabapple grows wild and it appears there are several varieties of them. Around Monticello they grow quite luxuriantly and bear heavily. Many years ago, I am told, large numbers of them were grafted and budded with improved varieties. These all failed. This failure, however, may have been caused by an injudicious selection of varieties. In Leon county, which joins Jefferson, there are several persons who have tried to produce the early Southern varieties, and have claimed success. In Hamilton and as far south as Levy county I have known a few trees to bear, but they have not encouraged a general effort to cultivate it. I have budded a few of each of about a dozen of the Southern varieties on LeConte pear stock, and they are growing off finely. It is barely possible that this valuable fruit may become acclimated at least in one or more varieties. Care will be taken to test their adaptation at various points, in the hope at least of finding some section where they will bear and add to our stock of fruits.

JAPAN PERSIMMON OR KAKI.

This is one of the most delicious of oriental fruits. Grafted on our native stock it succeeds finely, fruiting wherever the native variety does. The growth is slow, but its fruitiug qualities are good. It makes a beautiful tree and produces a showy fruit, and gathered when grown and hard, bears shipping to the most distant points. It ripens up after being plucked, and when fully ripe will keep for weeks if kept in a cool dry place. I have kept them for two months after taking them from the tree. It is my opinion that this fruit does not receive the attention it deserves. It certainly would be very profitable and popular if grown in sufficient quantities to produce a demand for it.

Its two great enemies, so far as I have discovered them, is a worm which eats into the roots, and the birds. A general cultivation of them would, however, meet the demands of the birds, and proper efforts may control the grubs. There have been complaints about the difficulty of getting them to live when transplanted, but I am convinced that this largely depends upon their preparation for transplanting. I have found a very small percentage of them to die, but I have cut them back freely and also cutting away lateral roots, taking great care to pack the dirt firmly around their roots and supporting them with a stake to prevent displacement.

The Department of Agriculture sent me the past spring fifteen varieties, freshly imported, out of which I have lost but three. I shall plant native seed on which to propagate them, half of which for five years will be given as per agreement to the Department at Washington.

FIGS.

The figs embraced every variety I could find in the State, but the cold of March, 1890, killed not only these but others which were on the Station when I took charge of it, and which were good size trees. A few have sprouted out from the roots and are growing slowly. Cuttings of eight varieties from Smyrna were sent me from the Department at Washington which I have rooted and are doing well.

It is a curious fact that this healthy and delicious fruit is not more generally cultivated in the eastern and southern portion of our State. Planted in protected places near the houses or on the south side of forest or fruit trees, it will stand the colds of spring time, and fruit heavy. It requires rich soil and should be fertilized if not near the houses. A dozen trees planted in a chicken yard will furnish shade and rich diet for fowls and all a family needs.

OSIERS, OR WILLOWS, AND FOREST TREES.

Seven varieties of Osier cuttings sent from the Department of Agriculture have been rooted and are growing finely. They consist of the Salix viminalis alba, Salix viminalis, Salix viminalis patula, Salix purpurea pyrimadalis, Salix Holis, Salix purpurea graciles and Salix uralensis serotena.

A variety of forest tree seed were also sent me, which came up, but succumbed to the dry spring.

MELONS.

Five rows of watermelons were planted for an early patch on the 5th of February. They began ripening by the 10th of June. The varieties were Kolb Gem, Pierson, Strawberry and Rattlesnake.

Holes two feet square by fifteen inches deep, and ten feet apart were dug, and a large spade full of green stable manure was put in them, on top of this a double handful of unkilled black cottonseed. The earth was then thrown in and mixed with a handful of blood and bone, when five seed were planted to each hill, after being soaked for twenty-four hours in tepid water. On cold nights the plants were protected. During the dry weather they were watered from a barrel half filled with chicken house manure, and then filled with water and allowed to remain a few hours before using; with a round stick holes were made near the stock and filled. The vines bore well and the melons were fine, weighing from twenty to thirty pounds. Another patch planted the 5th of March and fertilized with less manure. side by side with others, grew melons weighing from twenty to fifty two pounds, and were but ten days later.

Muskmelons planted at the same time and fertilized like watermelons, developed the same results as to the time of ripening. Melons need a complete fertilizer, and if the soil is poor a rich hill in which to plant them is necessary. Of watermelons I planted also Cuban Queen, Florida Favorite, Henderson's Green and Gold, Winter, Pineapple and others.

Kolb's Gem made the heaviest melons, the meat of which was as good as any. Out of the above varieties the most fastidious taste ought to be satisfied.

Canteloupes planted were Chicago Market, Delmonico, Osage, Baltimore and Bird. These were all good, but Delmonico, according to my judgment, was the best by very great odds.

STRAWBERRIES.

Several varieties of strawberries were tested, but the Station soil is too thirsty for them. Another year I will test them near the lake on moist land and in larger quantities, in order to study their enemies.

Quite a number of varieties were sent me by dealers to test, but all of them were too late to fruit. They were planted on fresh, moist land, but all died except the Everbearing, which have grown well and multiplied finely.

TREES FOR DISTRIBUTION.

Those who desire them must send in their names before the 1st of December.

All who receive trees from the Station are expected to take care of them and report to the Director their failure or success.

The trees sent out will be small, some of which will be dormant buds. Instructions will be sent with trees as to their treatment, cultivation, etc.

From one to three trees of each variety will only be distributed to each person. It is desired that the people will send in their names promptly and assist me in testing trees, which may be of value to the State. I propose to make the nearest railroad depot the point of distribution for each section. Trees for each neighborhood will be sent to some party who will distribute them. The name of each person will be tagged to the trees desired. Trees will be free, and the freight paid to the point of destination.

The following is the list of trees for distribution:

PEACHES.

May.—Peento, Queen of the South, Barrs' Daisy, Bidwell Early, Waldo, Prolific, Angel.

June.—Honey, Horn's Favorite, Dowling's Red. Big Red, Dwarf Japan Blood, Blood, Indian Blood, Stanley, Miccosukee, Mammoth.

July.—Golden Press, Golden Clear, Silver Press, Silver Clear, Onderdonk, White Cling.

August.—August Early, August Late, Watson's August.

September.—Jackson's Prolific.

October.—My Favorite (white), My Favorite (yellow), Gibb's October.

PLUMS.

Kelsey, Satsuma, Botan, Ogon, Nasu, Long Fruited, Chabot, Yellow Japan, Simonii, Pissardii.

PEARS.

LeConte, Kieffer, Bartlett, Clapp's Favorite, Gilbert, Petite, Margaret, Onandago.

APPLES.

Wallace Howard, Astrachan, St. Michael, Yellow Transparent.

OSIERS OR WILLOWS.

Salix viminalis alba, Salix viminalis, Salix viminalis patula, Salix purpurea, Salix Holis, Salix purpurea graciles, Salix uralensis serotena.

VEGETABLES.

CABBAGE.

PLOT 1.—This was a small plot 28x30 feet, width between rows three feet, length 28 feet. The seed were sowed September 16th in boxes (it is not necessary to sow in boxes) to protect them from sun. The plot was at the same time prepared for plants. Every two feet on a row a hole was dug with the hoe, making 140 holes, into which two pounds of compost No. 1, given above, was put and well mixed with soil, leaving a well defined hill as a mark for the plant. The seed bed was laid off in shallow rows four inches a part and the seed sowed, covered lightly, the dirt pressed with hand on seed. The plants were kept watered by a sprinkler and transplanted when ready. By the time the plants were ready to transplant, the manure in the hill had passed through heat so as not to injure them. The 2d of December the first cabbage was cut for the table. From that time until June this patch furnished all the cabbages necessary for a family of ten persons, besides many of them were given away to hands and other parties. This was done by sowing seed in November, December and every month afterwards until March. When six or eight cabbages had been cut their places were supplied by plants. When the plants were set a teaspoon of kainit and cotton seed meal was given each plant. In this way the patch was perpetuated. This experiment was made solely in the interest of the family. It demonstrates how a small plot can keep a large family in this excellent vegetable indefinitely. The amount of seed required after the first paper is very small, say one-fourth of a paper at a sowing.

PLOT NO. 2.

The growing of spring and summer cabbages have long since been abandoned by Floridians on account of their enemies. The cabbage worm and lice scarcely ever fail to disappoint the most hopeful and sanguine, and after a few trials the conviction forces itself inevitably that all effort in this direction is unavailing and time and money thrown away. The result has been that the fall and winter are considered the only seasons in which our climate would produce this popular vegetable. In consequence of this Florida has been made dependent largely during the fall and winter on the Northern States for cabbage. Annually our merchants order a great number of large crates to meet the demand of both town and country trade. To prevent this and supply our home demands, I commenced the following experiment. I selected a plot 168x63, and laid it off in three feet rows. On each row every two feet I dug holes and fertilized some of them with three ounces of Paine's Vegetable Food, others with same amount of Mapes', and also Bowker's, while seven ounces of Station No. 1 competed with six ounces Station compost No. 2 in others. These proved to be good fertilizers. They were mixed thoroughly in the soil and after a week from five to ten seed were planted in each hill. At the same time a seed bed was sown to supply vacant places if the seed failed to germinate in the hill. The seed were planted in hill in order to verify whether cabbages would head unless transplanted. The stand was not good owing to dry weather, but the seed bed supplied the missing hills.

In due time the worm made its appearance and began its work of destruction. By May 12th the cabbages were literally honeycombed with them, when they were sprayed with the following mixture: One ounce of Paris green to twenty gallons of weak soapsuds. This killed the worms, and in a few days the buds began to head, and by June 10th there were hundreds of edible cabbage in the patch; they are there to-day, July 27th. There were no lice to trouble us this season.

The popular opinion is that the use of arsenic poisons, sprayed or sifted on plants, is dangerous to health and life. Three weeks after spraying I made cold slaugh of a cabbage and it was perfectly healthy. From then until now they have been eaten by scores of people without any evil effect. When it is considered that twenty gallons with only one ounce of Paris green sprayed 800 cabbages, there was not enough arsenic to each, if all a plant received at the time of spraying had been eaten, to have injured a child. The commonly prevailing opinion that plants absorb poison sprayed or sprinkled upon the leaves is most certainly an erroneous one. Hence, this deadly poison and London purple should constitute a necessary and indispensable article to every one who either cultivates a kitchen or truck garden. So successfully have I used this poison, from the seed bed to the heading period of cabbages, and so harmless when used on the cabbage, that I unhesitatingly advise every family to procure it and keep it by them for immediate use. A tablespoon well mixed in four or five pounds of flour and sprinkled over the bed when the seed are sown, and repeated after the plants are up, will protect them from both the flea beetle and the cut worm, and thus prevent that delay and disappointment which has so often discouraged the gardener in time of seeding.

1. The experiment is a demonstration that spring cabbages can be protected from the worm. The lice pest, it is reasonable to suppose, can also be destroyed by spraying with Paris green or the kerosene emulsion.

2. Cabbages planted in hill will head equally as well as when transplanted.

3. A handful of salt dropped in the bud of each cabbage during the dry spell was a great help to the growing plants.

4. Ashes, dust, salt and lye used before the Paris green receipt had no perceptible effect on the worms.

5. The cabbages may be sprayed by a spraying pump, or if the patch is a small one, by a small hand syringe.

6. The experiment demonstrates that seed sowed thickly causes the plant to grow spindling, but if only one-half to one inch apart in drill they are more stocky.

7. In transplanting a hole should be made by a round stick deep enough to let the plant down to the leaves, whether it is four or eight inches high. A little water poured on each when transplanted settles the earth around the roots.

8. To protect against cutworms take one teaspoon of Paris green to two pounds of flour; mix well and sprinkle around and between plants. An old mustard box, the top perforated with holes by a nail, will serve the purpose admirably.

9. During dry spells a handful of salt dropped on the bud will attract moisture and keep the plant growing. The cabbage needs salt, and for this reason kainit is a good fertilizer for it. But kainit must not be used on the bud in the place of salt, as the potash in it will destroy it.

10. The seed bed in the fall is sometimes assailed by bugs and grasshoppers. Paris green will kill the insects, and the bed being a small one can be protected from other enemies, such as birds, chickens, etc., by a frame.

11. A frame covered with wire webbing, small mesh, protects the plants against chickens and birds and makes a convenient frame over which brush or an awning can be thrown as a shade when the sun is hot.

12. The cabbage bed should be worked every week or ten days by both plow and hoe and dirt thrown to plants. A garden hand plow serves the purpose on a small plot.

BEETS.

This vegetable was not planted with the object of estimating quantity per acre or its sugar-producing qualities, but in order to test fertilizers which would produce it on our dry and sandy lands. Several varieties of common red turnip beet were selected.

The plot was broken up and fertilized with 1200 pounds stable manure, 400 each kainit and cotton seed meal and 200 acid phosphate, and left for two weeks for assimilation of soil and fertilizer. Seed were sowed in a drill October 1st, and a stand too thick for rapid growth was obtained. Draws for missing places were taken out where they were thickest, and it was not until January a mess was ready for use.

February 2d, with garden plow, a furrow was run very near them and fertilized with salt and gas lime equal parts at the rate of

1000 pounds per acre. A part of the fertilizer was also distributed between beets and furrow covered. In a little while the beets began to grow afresh, and in a few weeks they were ready for the table. During the dry months of April and May, when they showed signs of suffering, they were again fertilized with salt. This gave them new energy and they began a new growth. Some of those beets are still there and promise to remain at least until they are a year old. A peculiarity is that while they were in size from an egg to a saucer they have been without an exception tender and delicate. The beets, like the cabbage, are greatly benefited by salt applications not only when planted but during dry spells.

On February 3d two small plots on the same kind of soil, dry, sandy and hilly, were seeded and fertilized, one at the rate of one-half ton of Paine's Vegetable Manure and 750 pounds of salt per acre. The other with Station compost No. 2, one and one half tons, and 750 pounds salt per acre. These grew off rapidly, producing tender large beets, and are still remaining in the ground without rotting.

On March 12th another small plot was sowed in drills and fertilized with Station compost No. 1 at the rate of one ton per acre. The soil was fresher and better, being moist but tiled. The growth was rapid, the roots large, weighing from one-half to three pounds each. A few in good condition still remain July 27th.

EGG PLANT.

The egg plant in South Florida in some localities is troubled by a disease which at times very materially interferes with the grower's profits. This vegetable, one of the most valuable to ship North and West, and very popular, is easily raised, and when planted in early spring lives till frost, and bears heavily. I planted it quite largely with the object in view of studying its disease and enemies, but on the Station it developed none.

THE McNEIL PEA,

Which originated in this town (Lake City) and popular as a shipper, being a good bearer and hardy, was also tested. It is a little later than the very early varieties, but a bunch pea of good size and full pod. This pea is very scarce and all raised were saved for seed. It is a popular market pea and for that reason greatly desired by shippers.

Other kinds of vegetables were tried and studied, but nothing of importance worthy of mention was developed, such as

Okra; Tomatoes; Parsnips; Spinach; Carrots, yellow and white; Pepper, seven kinds (Large Bell, Red Cluster, Sweet Mountain, Norcross Giant, Mammoth Golden Queen, New Sweet Spanish); Oyster Beans; Squash (Giant Summer or Crookneck, Yellow Bush, Giant Summer, Cashaw); Beans (Mohawk, Valentine, German Wax, Speckle German Wax, Black Wax); Lettuce; Radish; Cucumbers; Champion of England Pea; Extra Early Pea.

CEREALS.

OATS.

The following crops were planted on old land unfertilized:

Red and White Texas Oats.—The stand was medium, and heads medium; weight per bushel, medium.

Ninety Day or Summer Oats—The stand good. This is an early but light oat. Planted in January, it ripens first of May, and is very popular in this (Columbia) county because of its earliness, and has the reputation of being a sure crop. For two years this oat has been planted on this Station and did well.

The DePass Oat (it should be called the Anderson oat, because Dr. Lewis Anderson, of Ninety-six, South Carolina, improved it through twenty years of patient effort) was introduced into Marion County by me about twelve years ago. My name was given to it by the farmers simply because I introduced it in the county and to distinguish it from other varieties. It is thought by some to be the best for that section, and has been adopted by them to the exclusion of other varieties. It is red, rust proof, grows high, heads heavy and weighs35 pounds to the bushel.

Black Barley was sowed broadcast on very old and sandy land, on which rice had been cultivated the two previous years, at the rate of one bushel per acre, and fertilized with kainit, 800 pounds per acre, and planted the middle of January. Seed were furnished me by Rev. James Stanton, Ormond, Fla.

This test was promising. The stand was a good one and to my surprise, it grew off rapidly, making very fair heads, considering the very dry weather of April and May. Encouraged by this trial I shall plant early in the fall another plot. It was also drilled and the indications were as promising.

Such other things as Sorghum, Sugar Cane, Corn, Wheat, Kaffir Corn, Flour Corn, Pinders, Cotton, Tobacco, Sweet Potatoes, Rice, and Corn and Sorghum for ensilage, were planted and will be duly reported in Bulletins.

A silo of corn and sorghum has been put up and a future report will be made of it.

GRASSES.

Sixty grasses, both foreign and domestic, were tested on the Station this year under the direction and supervision of the Department of Agriculture at Washington. Fifty-nine of these were a total failure, not one giving any promise of success. This may be attributed to the time of planting, which began on the 29th of January. The experiments in grasses and forage plants will be continued this fall and the coming spring, in the hope of doing better than last year.

The Texas Blue Grass I found on the Station in the spring of '89 when I took charge. It was sowed in drills, on one of the best pieces of land on the Station, was fertilized and did well, seeding fully and the next season spreading over the entire plot. From that time until now it has neither been worked nor fertilized, and it has held its own against weeds, other grasses, blackberries and broom straw, making an early fall, winter and spring pasture. Last December I sowed in drills on a highly fertilized sandy hillside seed which came up and formed a splendid stand. The growth was slow and unsatisfactory. It may be that another season will show better results, but I am doubtful. From the experience I have had with this grass it is my opinion that on low rich land it will make an excellent pasture, and it may do well on good, firm, high land, but when it is hilly and light it does not promise to be of much value. Time, however, is required to decide more fully on its merits and the experiment is fully under way.

THE BURMUDA GRASS can be propagated both from the grass and seed. It is a mistake that the grass itself grows so easily as is generally stated, unless the soil is good and the seasons specially favorable when planted. After it obtains a hold on the soil, either on sandy hills or moist or good uplands, it is tenacious of its claims and rights and difficult to get rid of. For two years I have cultivated where it had a limited hold at first, but to-day it is a thousand times more deeply imbedded in the soil than ever, and promises to stay there, spreading constantly. It makes a beautiful lawn in the spring and summer, and in many places in East and South Florida it is possible that it would do well in winter, if top dressed with fertilizer in fall, and kept mowed especially after each frost. Cattle are very fond of it and seemingly prefer it to any other kind, even when native grasses are highly fertilized and growing rapidly.

STOCK.

HORSES.

During the past year the Station has lost every horse it owned. The disease apparently assailed everything that came in contact with it for any length of time, but it was entirely local. During the year I lost two very fine mares, which I had brought on the Station for buggy purposes.

The Station mare Daisy was the first to develop the disease but not the first to die. The first symptom noticed was lameness, without any apparent swellings or bad feet. This gradually increased, sluggishness ensued, then occasional spasms, then lying down with inability to get up, and when helped up trembling in all the limbs, finally not able to stand when helped up.

The first horse that died was my own, a fine gray mare. She, after being here a month, became lame. For six weeks this lameness in turn grew worse and better. A pressure of work forced her in the plow and hauling for a few days, after which she was very lame and thought by some to be foundered, but I did not. She grew better, and hope was entertained of her recovery, but suddenly her stiffness and lameness increased, and after two months from the first attack she died.

During the fall the two Hambletonians—the stallion and mare—showed lameness. This was thought to be diseased hoof and they were so treated. The lameness and general soreness increased, when the horse's head under his eyes and lower jaw began to enlarge and increase in size very rapidly. (His appetite remained good, and it is a singular fact that all through the sickness the appetite of the horses remained good until they became helpless and could not eat.) With this development the lameness and stiffness of joints became more manifest with tremblings all over and general uneasiness. When he laid down it was with difficulty that he got up again. After awhile after lying down he had to be assisted up, and finally was unable to stand when lifted on his feet.

Mona, the Hambletonian mare, had all the symptoms of the horse with the exception of the enlargement of the head. Her shoulders and joints enlarged however, which would disappear under treatment with liniment. When she died, on being cut open, it was found that the ribs on both sides were all broken, some of them in three places, caused by her weight in lying down. They were so soft in places as to be cut easily with a knife. The broken ribs on one side of her were observed at least two months before she died. Her brain, liver, kidneys, lungs and stomach did not show signs of disease or general inflammation. In the region of the kidneys the backbone was quite soft. The horse's kidneys were said to be seriously affected.

In January the mules showed the same symptoms of lameness, but it soon passed away.

In the meantime another mare of mine became lame, which was used in a buggy and, being in foal, was thought at first to have diseased feet, then rheumatism, but finally her face and jaws began to enlarge and the fatal disease rapidly developed. In the meantime she foaled a colt and in three weeks died.

With the exception of the last mare of mine and the mules, Dr. J. C. Neal, nominally the veterinarian of the Station, attended the sick horses until in December when, perceiving they grew worse, I employed a Dr. Williamson who professed to be a skilled veterinarian. His treatment failed. At the suggestion of my superintendent I employed on the Station mare Mona and my mare Clara, a Mr. Silas, who had some reputation in curing horses afflicted in this way. His treatment, however, did not avail. Horses which have their heads to enlarge under this disease are said to have the "big head," but I am satisfied it is only a symptom of the disease. Manifestly every horse and mule that was sick was similarly afflicted, and those which died showed by every action that the same disease killed them all.

The books do not discribe it, which is said to be unknown North and West. Blind teeth are said to produce it, but this is a mistake, since four of the five had no blind teeth. A year before the horse's head began to enlarge I had blind teeth taken from him, and hence they could not have produced it in him. The enlargement of the teeth is evidently a result of the disease.

The treatment pursued by different parties vary much, and is very severe. I can suggest nothing. I am told by those who seem to be familiar with it, that mules do not have it. However, it is clear the mules had the same sickness that killed the horses, although they recovered and are in fine condition now. The Station is without a horse. Quite a number of horses in this county have been sick and a number died. The Hon. D. N. Cone lost five, and Mr. Silas, who attended two on the Station, Mona and my mare Clara, informs me that he is constantly traveling, attending sick horses, a peculiarity of the sickness being that they get down and are not able to rise without help. A skilled veterinarian would no doubt be of great service to the State, especially to study the diseases peculiar to the climate and prescribe remedies suitable to recovery.

COWS.

The cows consist of two Jerseys and one high grade Jersey. These cattle have not developed the amount of butter for which they have been celebrated, although they are in fine condition. While I have made no tests either in the laboratory or with separators, still they have been fed highly, fed as much so as cows which represent from two to three pounds of butter daily. The largest yield I have received, churning the old-fashion way, was one pound per day. I propose very soon to make chemical tests and have ordered apparatus for this purpose and will purchase at an early day a separator. From my experience I have grave doubts that the Jersey is so far superior to our native stock for our climate, if the latter are carefully selected and properly treated.

I had the misfortune to lose the Holstein-Fresian cow. In attempting to rise up, when in her stall, she slipped and broke her neck. Her mate, a magnificent beast, is in good order and health. This animal in passing through acclimation had to have his head tied up day and night through early spring, summer and fall, to keep him from eating sand. It was with difficulty that he could be led to water and be kept from eating it. Salt was always kept in his trough; he was fed on green and dry food, ashes and lime were given him, and indeed every device and treatment was used, but they failed. Nothing accomplished the cure but the rope. After the first season he showed no more disposition toward this morbid appetite. Persons who buy cows from Northern and Western States will do well to take the precaution to protect against this disposition of fine grade cattle by keeping them on a board floor or tying their heads so high as to prevent them from reaching the ground. I have known cattle to eat sand a little at a time, but eventually to die from it. There is but little doubt in my mind that instead of acclimation fever affecting imported cattle that this is the main cause of so many dying in Florida, brought from States north and west of us.

My efforts with cattle have been mainly to produce feed cheaply that would produce a good flow of rich milk. In Florida the all important question is cheap feed. With corn at from 60 cents to $1.10, and oats from 50 to 80 cents per bushel, the dairy can not be of much profit in our State. Sweet potatoes are an excellent feed, but it is not demonstrated that they can be raised cheap enough under the present system of cultivation on old land. I am now running experiments in potatoes with this object in view. If the representations made are correct as regards the enormous yield of cassava per acre, its value as a rich feed for cattle, and the cheapness of its cultivation, then the problem of cheap feed will be solved But this has to be demonstrated, which I hope in time to do. There are some locations in Florida where stock farms would be very valuable, possessing meadows which yield early spring grass which should be utilized in this department of agriculture. For no State offers a better market for butter and meat products, nor can any climate be found healthier or in which fine cattle can be bred more successfully than ours The great question is cheap feed.

HOGS.

The hogs I have tried have been the Razorback, the Poland China, the Berkshire and the cross between the Poland China and Razorback. Without going into detail to any extent I will state that I bought a pure Razorback with six pigs, when pigs were six weeks old. After keeping them a month on the Station I took the six pigs and penned them in my yard and fed them on slop from the kitchen. I reduced the number in six weeks to one and kept it until it was ten months old, then I returned it to the Station and fed it five months in the horse lot. It weighed, when slaugthered, 320 pounds and netted 280 pounds. At the same time I slaughtered a Berkshire, three years old, which weighed 317 pounds and netted 258 pounds. I also slaughtered three pigs ten months old, fed on slops for six months and then on corn for four months, and they netted 125. 148 and 159 pounds. The lightest was thorough-bred Poland China. The next, a cross between Poland China and a tolerably well kept country hog, with some good blood, and the last and best, a cross between Poland China and Razorback. The Razorback I observed fed enough to keep it from rooting, did not develop the phenomenal snout so characteristic of this abused breed. Crossed on improved stock it cost more to feed them, but if fed properly when young, with proper treatment they develop into a compact, broad back and heavy hog. Starve them and give them the range for a living and we have the piney woods rooter, in which, if allowed to become two years old before fattening, we have a hog which takes time and money to bring it to an edible condition.

I have a trio of Jersey Reds which make large hogs, the chief characteristic of which is their prolificness. These I will cross on other hogs, and test their growth and fattening qualities. The Poland China did not do well on the Station.

Persons living in East and South Florida, and for that matter any where in the State, can save their hams and shoulders by grinding them into sausages. If, when fresh, they are hung up and smoked several days, then cooked and packed away in hot lard, they will at the expiration of six and eight months be as fresh and as nice as when they were put up. I kept them that long and expected to keep them a year, but after eight months they were gone.

CHICKENS.

The experiment in chickens was to determine whether fine breeds or any breeds could be raised profitably as a business for market in our State. This question has often been discussed and a great many people were of the opinion that a chickery in Florida, as an independent business, would be profitable. With this object in view, I bought eleven strains and, to keep them pure, prepared separate pens for them. I also bought an incubator with brooder, and made elaborate arrangements for a complete test. I employed a man specially to take charge of this experiment, who was skilled in the use of the incubator and who had large experience in the business. Poultry journals were taken and the best feed was furnished. There were as many hens outside of the yard, and were allowed to run at large and feed where they would, as were inside the pens, while those in the pens were fed on meat and the richest of egg-producing food. There was a good yield of eggs and the fowls of each breed sustained their reputation in this line, but the great trouble was that, while the incubator worked all right, the eggs would not hatch except in limited numbers. The eggs did not appear to be fertile.

The chickens outside without the feeding and attention, such as those inside the pens received, with the run of the woods and the fields, layed as many eggs, and hatched more than the incubator did.

The experiment was a demonstration that the cost of feeding chickens for the market, when the price at ten weeks old was twenty-five cents, could not be a profitable business. For at the lowest price food could be purchased, a chicken ten weeks old would cost twenty cents. It therefore would take 1,000 chickens to make a profit of $50.

To run a chicken farm a man must like the business. He must have peculiar adaptation for it. He must study their diseases and know how to physic them, and in a word, be up in the business fully.

If prices such as I paid for stock, ranging from $5 to $8 per trio, could be had, then a chicken farm would be profitable. But to raise them for market or for the value of eggs, at the rate that food is worth and the attention they demand, is an uncertain and, in my judgment, an unprofitable business for any one to undertake.

If a person lived near a large city where the refuse of large hotels could be had for the hauling, such an industry might be made profitable.

My opinion is that the profit in chickens lies in each farmer having from twelve to thirty hens, with one to three cocks of the best breeds, which have the run of the barnyard, the kitchen yard and the fields, and which can mostly feed themselves. If hen houses are built and places prepared for them to lay and hatch in, they will keep the family in eggs and poultry with some to spare.

The Wyandottes, White, Red and Silver Wing, and Plymouth Rock, both White and Barred, are good layers, good hatchers, good mothers and fine table fowls both when young and old.

The Leghorns are the best layers. Between the White and Brown I should select the Brown. The Brown Leghorn is a very thrifty chicken and one of the best foragers.

FLORIDA PHOSPHATES.

Experiments in Florida phosphates will be very generally made, but all interested in them are referred to Bulletin 13 and to Dr. Pickel's report in this number, in which very valuable information on the subject is fully given. From them it will be seen that their use, in order to obtain the best results, must be in connection with other elements of plant food. Farmers and fruit growers should not be misled by the extollation of soft phosphate or of acid phosphate as all that is necessary to be used to secure either good crops or fine growth of trees or much fruit. Those who make these claims are not careful observers and their knowledge of the elements of plant food is limited. Phosphate can only perform its part (and it is a very important part) as plant food, but nitrogen and potash are as essential factors, and to make each accomplish their best results, all must be used in such quantities as the character of the soil demands. Experiments with Florida phosphates, hard or soft or acidulated, would not likely develop any new facts than those referred to in this and Bulletin 13, unless it be that soft Florida phosphate is more readily available than hard rock ground fine.

TILING.

The tiling has been of great service in draining springy land. It has proved a decided success also in converting land which was boggy into good dry soil. The kind used was the box tile made of heart pine.

It was made by taking 20 foot pieces, 1x4, for bottom and top, and 1x2 for sides. To form a joint the bottom extended four inches on one end and the top four inches on the other. Crate slats were sawed four inches long and slipped under each nail between plank to give vent to water. This size plank would give a two inch tile large enough for ordinary purposes. It was necessary to place these tiles from 15 to 30 feet apart. The ditches dug for them varied from 18 to 36 inches deep. The value of underdrainage of land cannot be too highly estimated. It is costly but then it pays. The fall necessary to success need not be very great, but care should be taken that the tile be laid on an incline or else it is liable to choke.

BUILDINGS.

In accordance with your action at your last annual meeting, held June 10th, 1890, I have erected on the Station a Director's dwelling. This is a commodious eight-room two story cottage. The rooms are 15x18 feet, and, with its outdoor buildings, cost in round numbers $2,626. I have also completed a laborer's house, which was in part built by the hands of the Station.

The buildings on the Station and their approximate value are:

1 Director's dwelling	$2,626 00
1 Foreman's "	800 00
2 Laborers' cottages	350 00
1 Horse stable and barn	1,125 00
1 Dairy	150 00
1 Cow stable	500 00
1 Fertilizer, tool and wagon house	550 00
1 Hay barn	250 00
2 Silos	75 00
1 Chicken run with houses	350 00
1 Incubator house	50 00
1 Shed for machinery	350 00
	$7,176 00

These buildings are in good repair and meet the present demands of the Station except a couple of sheds for general purposes.

Respectfully submitted,

JAS. P. DEPASS, DIRECTOR.

FINANCIAL STATEMENT

FOR THE YEAR ENDING JUNE 30, 1891.

CR.

Salaries	$5,664 02	
Labor, freight and merchandise	3,148 73	
Laboratory and entomology	186 38	
Incidentals	461 87	
Expenses of Board Trustees	273 95	
Periodicals	22 80	
Bulletins	418 50	
Postage and stationery	112 45	
Expenses of Director	285 40	
Fertilizer	322 83	
Farm machinery and hardware	302 45	
Feed and seed	734 13	
Building	750 00	
Traveling expenses of Board Trustees and Director		
To A. and M. Colleges	150 00	
Land and rent	170 00	
Insurance	88 13	
Fruits and flowers	24 60	
Water tax	22 54	
Membership of Directors' Association	10 00	
Hogs	15 00	
Veterinarian	26 00	
Expenses of exhibit at Ocala Exhibition	75 00	
DeFuniak sub-Station	1,235 08	
Fort Myers "	999 98	$15,499 84

DR.

Assets of Station		
Cotton, laboratory, etc.	275 84	
June 30 – On forage experiment from Department of Agriculture, Washington.	224 00	
	$ 499 84	
1st quarter—August	3,750 00	
2d quarter—October	3,750 00	
3d quarter—January	3,750 00	
4th quarter—April	3,750 00	
	$15,499 84	$15,499 84

F. J. PONS, TREASURER.

ANNUAL REPORT OF J. M. PICKEL, CHEMIST.

Rev. J. P. DePass, Director Agricultural Experiment Station:

SIR—The following brief summary of the work of the chemical laboratory during the past year is respectfully submitted:

SAW PALMETTO.

Potash.—The claim is made that the ash of saw palmetto root contains a large per cent. of potash. An analysis of ashes, prepared and sent on by Mr. E. W. Amsden, of Ormond, over a year ago, was found to contain only 1.10 per cent. of potash. We were lead to suspect that the root from which this ash was prepared was an old one that had been long dug and exposed to the rain. We found this to be true; the root had been kicked about on a beach for two or three years. This induced us to make some experiments as to the effect of exposure to rain on the content of potash. The ash of a freshly dug root freed from adhering dirt contained 40 per cent. of potash and 20 per cent. of phosphoric acid (equivalent to 43.6 per cent. of tricalcic phosphate. The ash from a piece of the same root exposed three months (during the dry season, however,) to rain contained only 34.75 per cent. of potash and 20 of phosphoric acid. Doubtless the per cent. of potash will be much further reduced still when the rainy season is over. The difference in the solubility of potash and phosphate is incidently strikingly brought out. This percentage of potash is surprisingly large. The ash of only a few of the hard woods contains so much potash. The ash of the White Oak and of the Ash contain respectively about 46 per cent., that of the Dogwood and the Hickory 28 per cent., those of the Post Oak, Red Oak and Magnolia 22, 25 and 19 respectively. It would require about twenty tons of thoroughly air-dry palmetto roots to make one ton of ashes.

Tannin.—It has been long known that there is tannin in the root of the saw palmetto, but statements as to the quantity and value are conflicting. One of the most intelligent and observant gentlemen of this State informed the writer recently that he had several years ago sent a number of tons of the roots to a tannery in New York, and that they were pronounced as of practically no value. An analysis by the Massachusetts Experiment Station reports only a *trace* of tannin. On the other hand as high as 12 per cent. has been claimed. Senator O. B. Smith, of St. Augustine, sent to the Director of the Station some weeks ago a piece of calfskin tanned in twenty-eight days by the palmetto root. The work is beautifully done; the texture, color and general appearance of the leather are fine. We have made some determinations, and have thus far found from 4 to 6.25 per cent. of tannin. These determinations were made in the intervals of other work, and are not final nor satisfactory. The investigation will be continued. Oak bark contains from about 6 to 14 per cent. of tannin.

The palm or leaf of the palmetto contains little or no tannin. Our percentages have reference to the root only, that is to the entire root, both the fibrous and non-fibrous part. We have found that almost all of the tannin resides in the part of the root which remains after the fiber is extracted. This fact is an important one; and naturally suggests the running of a tannery in connection with fiber extraction. In fiber manufacture the non fibrous part has, of course, heretofore been a waste product. It is not improbable that where the entire root contains 4 to 6 per cent. of tannin, the non-fibrous part alone will contain 8, 10 or 12 per cent. This point is being followed up. Points worthy of investigation in this connection are: Whether or not different species of the the saw palmetto may not contain different quantities of tannin; whether or not, the same species may not at different seasons of the year, as well as at different stages of its age, etc., contain different quantities of tannin.

CAMPHOR.

The camphor tree, as is well known, thrives in Florida; and it is a question if the production of camphor might not be made a profitable industry. We have now in the laboratory a quantity of the outer leaves and twigs (prunings) of a camphor tree, awaiting an opportunity for extracting the camphor, determining its kind and percentage.

SOFT PHOSPHATE.

The question of how the "soft phosphates," particularly such as contain much iron and alumina, can best be utilized, continues to be often asked. It is not at all likely that low grades can find extended use as long as the high grades are so abundant, except possibly in a local way where the deposits are close to the crops to be fertilized. Perhaps the best way to utilize them is to grind them to a powder and broadcast them in large quantity. The action of soil and weather will slowly, but surely render them available as plant food. It should be borne in mind, however, that they contain no nitrogen and practically no potash, and that these elements must be added. The composting of these phosphates, particularly such of them as contain considerable corbonate of lime, with muck, is to be recommended.

We are sometimes asked also as to the practicability of converting these low grades by means of sulphuric acid into soluble or superphosphate. Last winter a rock which analyzed,

Moisture	1.77	per cent.	
Silica	36.90	" "	
Phosphoric acid	21.49	" "	equivalent to
	46.91	" "	tricalcic phosphate.
Ferric Oxide	0.44	" "	
Alumina	13.06	" "	
Lime	28.00	" "	

was finely pulverized and treated with sulphuric acid of 1.5 specific gravity in the proportion of four parts by weight of the rock to three parts by weight of the acid. After mixing and standing two days it analyzed:

Moisture at 115° C	22.32 per cent.
Total phosphoric acid	12.50 " "
Water-soluble phosphoric acid . . .	11.31 " "
Insoluble " " . . .	1.08 " "
Reverted " " . . .	0.11 " "

After standing 89 days, a larger portion of the same rock treated according to the same formula (4 parts rock to 3 parts of acid 1.5 specific gravity) analyzed:

Moisture at 115° C	18.10 per cent.
Total phosphoric acid	12.79 " "
Water-soluble phosphoric acid . . .	7.56 " "
Insoluble " " . . .	1.80 " "
Reverted " " . . .	3.43 " "

It will be observed that, when freshly made, the superphosphate contained 11.31 per cent. of phosphoric acid soluble in water, and 0.11 per cent. of reverted; but that after standing three months, the water-soluble phosphoric acid had dropped to 7.56 per cent. and the reverted had risen to 3.43 per cent. "Reverted" phosphoric acid is acid which, having been made soluble in water, has "reverted," or gone back, into a form no longer soluble in water (or rather no longer easily and readily soluble in a small quantity of water). "Reversion" is due in part, so it is thought, to the presence of iron and aluminium, and this is one of the reasons that their presence in large quantity is objected to. Another deleterious effect is that they tend to render the superphosphates "sticky," and thus prevent their drying out readily and becoming pulverulent. In this particular instance the drying out process was slow, and even to the last the goods were somewhat moist, not so much so, however, as to prevent their being sacked and transported.

In the commercial valuation of fertilizers, phosphoric acid soluble in water is estimated at about 8 cents a pound, reverted at about 7½ cents, and insoluble (in phosphate rock) at about 2 cents. At these rates, a ton of our superphosphate (three months old) is worth $18.70. The rock from which this superphosphate was made contained, in round numbers, 47 per cent. of phosphate; a 75 per cent. rock would give a fertilizer containing 18 or 20 per cent. of water-soluble phosphoric acid. Where there is long transportation, and consequently much freight charges, it is far better for the farmer to buy the high grade goods.

MUCK.

In a previous year several samples of muck were analyzed and a few additional ones this year. In all about twenty samples have been examined. In all of these the percentage of moisture, organic matter, ash and nitrogen has been determined, and in eight of them all the fertilizer constituents. The analysis of these eight is as follows: Moisture, maximum 89 per cent, minimum 11 per cent., average 49 per cent.; organic matter, maximum 68 per cent., minimum 11 per cent., average 30 per cent.; ash (including sand and "dirt"), maximum 69 per cent., minimum 0.3 per cent., average 20 per cent.; nitrogen, maximum 2.88 per cent., minimum 0.44 per cent., average 1.11 per cent.; potash, maximum 0.77 per cent., minimum 0.004 per cent., average 0.14 per cent.; phosphoric acid, maximum 0.24 per cent., minimum 0.01 per cent., average 0.10 per cent.; Insoluable Matter, maximum 56 per cent., minimum 0.13 per cent., average 17 per cent. This has reference to wet muck. The averages for barnyard manure may be put at about the following: Moisture, 70 per cent.; organic matter, 22 per cent.; ash, 8 per cent.; nitrogen, 0.41 per cent.; potash, 0.40 per cent.; phosphoric acid, 0.28 per cent.; insoluble matter, 7 per cent.

So far as any conclusions are warranted by the limited study of Florida muck, they may be stated thus:

1. Muck is exceedingly variable in character and value.

2. Muck is to be regarded as a nitrogenous fertilizer, containing much more of that element and much less of phosphate and potash than barnyard manure.

3. Hence, in the use of muck as a fertilizer, one should expect that it would need to be supplemented by phosphate and potash.

4. Some mucks which contain a high percentage of organic matter, contain a high percentage of nitrogen; others with large quantity of organic matter have, on the other hand, but little nitrogen. One should expect the first to possess value as a *nitrogenous fertilizer* as well as a *mulch*; whereas the latter could be valuable mainly as a *mulch* and *mechanical improver* of the soil.

5. While not all muck with high percentage of organic matter contains also a high percentage (2 per cent. or more) of nitrogen, we have found no muck with less than 50 per cent. of organic matter which contained as much as 2 per cent. of nitrogen.

6. In judging of the value of a muck, at least three things should be taken into account: (1) the quantity of organic matter (the greater this the better the muck, other things being equal); (2) the kind of plants from which the muck has been formed (muck from succulent weeds, grass and mosses would likely contain more nitrogen than that from woody and fibrous substances); (3) the degree of decomposition (except, perhaps, for purposes of mulching, the more disintegrated and decayed a muck the better, other things being equal).

The plant food in muck is generally understood to be in quite an inert and unavailable form. In view of the fact that much of our Florida muck contains a surprisingly large per cent. of nitrogen, the best methods of composting or otherwise treating it, to render the nitrogen soluble, is a subject worthy of careful study and investigation. The composting of muck with finely ground phosphate rock, containing a goodly per cent. of carbonate of lime, is to be recommended as likely to give good results.

ANALYSES OF THE ORANGE.

Though isolated analyses of the orange have been made, no complete and extended study of it from the standpoint of chemistry has, so far as known to the writer, been attempted. A beginning in that direction was made last winter; to carry forward the work to a satisfactory degree of fullness will doubtless require several seasons. The work for this season was interrupted and will not be finished under several months. The work was to include a test of the *keeping qualities* of the leading varieties of the orange; the determination of the percentage of peel, pulp, seed, juice, sweetness (per cent. of sugar), acidity (per cent. of acid), and nutritive constituents; the quantity of plant food in the orange, as a whole, and incidentally in the peel, seed, pulp and juice separately. In attempting to carry out all these phases of the undertaking, difficulties of an unusual nature in plant analysis were encountered, and much of the work of this season can be regarded as only preliminary, furnishing experience by which we may be guided in the future.

GRASSES.

The nutrients in several grasses and weeds were determined during the year, and the importance of the beggar weed as a forage plant emphasized. Assuming (what is quite probable) that the digestibility of properly cut and cured beggar weed is equal to that of average meadow hay, the former is a more valuable feeding stuff than the latter.

KAOLIN.

A large number of samples of what was supposed to be kaolin have been received; only two of them, however, have been analyzed quantitatively, the others were merely examined and pronounced up qualitatively. Some of these samples are apparently of good quality and promise well, though neither of the two samples analyzed were found valuable.

CEMENT.

The composition of one or two rocks and clays analyzed during the year suggested the possibility of their being utilized for the manufacture of cement, and in the intervals of other work some hurried tests in this direction were made. They met with only a moderate degree of success. The subject is, however, one worthy of more extended and careful consideration.

BUREAU OF INFORMATION.

One of the most useful features, perhaps, of our work has been in the capacity of a *bureau* of *information* on all matters of chemical industries. All sorts of substances are sent us with request for information as to their value. These are all promptly examined and the senders informed as to result. Whenever this preliminary examination indicates something of probable value, the sample is labeled and set aside for future quantitative analysis. These examinations require no inconsiderable amount of time and often the exercise of much discrimination.

In addition to this, information is sought, questions asked on a wide range of topics, involving the application of chemistry to agriculture. It will not be amiss to illustrate this side of our work by giving a few of the questions which we have been called upon to answer:

A desires to know if potash, in the form of wood ashes, has not a better effect on sour soils, or soils containing soluble salts of iron, than when in the form of sulphate of potash.

B desires to know what effect ashes or sulphate of potash would have on bone meal, and what effect lime would have on bone meal in the soil.

C desires to know how the potash in feldspar can best be made available.

D desires to know for what agricultural uses certain soils, of which he sends samples, are best adapted, and what treatment and fertilizers are best suited to develop their good qualities.

E desires to know the value of raw phosphate as compared with bone. Is the phosphoric acid in the raw phosphate in soluble condition as immediate plant food? Will it answer in the place of bone meal?

F desires to know the value per ton of low grade phosphate as compared with ordinary stable manure and the best method of preparing it for use.

G desires to know if a certain substance would make a good base for a commercial fertilizer; if any of its elements would injure vegetation, and what should be added to it to make a first rate fertilizer.

H desires to know if soft phosphate can be made soluble by sulphuric acid and the formula therefor.

I desires to know the best method of drying fish scrap.

J desires to know the value of fish scrap as a fertilizer, and the best method of utilizing it as such.

K desires to know if a given sample of water is safe for drinking.

It is not pretended that all questions of the foregoing kind can be answered, but they are always promptly replied to, and the best information we have given. The time consumed in the correspondence is by no means inconsiderable.

One or two lines of chemical investigation which might in the near future be profitably taken up, are:

1. What conditions in our Florida climate are most favorable to nitrification? The end in view in this investigation would be mainly to ascertain the best method of utilizing Florida mucks, many of which are rich in nitrogen.

2. Can the low grade phosphates be profitably utilized as a fertilizer, and if so, in what form best—in a finely pulverized condition merely or as superphosphate?

3. Careful analyses of representative samples of artesian and other waters used in irrigation. There is a suspicion that some of them contain saline substances which in the course of time, by accumulating in the soil, might prove an injury to vegetation.

4. A careful study of the *vergin* soils of the State and of the vegetation thereon. Study of this kind, based on carefully made chemical and physical analysis, would tend to reveal the minimum of each particular plant food consistent with fertility, and would furnish a basis for the intelligent application of fertilizers.

Respectfully submitted,
J. M. PICKEL, CHEMIST.

ANNUAL REPORT OF J. J. EARLE, ASSISTANT CHEMIST.

To Rev. Jas. P. DePass, Director:

SIR—Below is given a statement of the analyses that have been made by me from August 1st, 1890, to July 31st, 1891:

ORANGES.—Analyses of fifteen varieties of oranges have been made, with a view:

First—To determine the amount of peel, pulp, juice and seed, a well as the percentage of sugar, acid, solids, etc., of the juice of each variety taken separately.

Second—A complete analysis of the ash of each variety, also a complete analysis of the ash of the seeds, pulp and peel of each variety taken separately, these analyses being made with the object of determining the amount of potash, phosphoric acid, lime and other fertilizing constituents.

PHOSPHATE ROCK.—Twenty-six complete analyses of phosphate rock received from farmers throughout the State.

Four special analyses of acid mixed with phosphate rock containing a high percentage of alumina, the results of which were published in Bulletin 13.

GRASSES AND FEED STUFFS.—Fifteen analyses of some of our common grasses, rice hulls, chicken food, etc.

ASHES.—Ten ash analyses, including the ash of grasses, saw palmetto root, oak leaves, pine straw, etc.

TANNIC ACID.—Four analyses of the tannic acid in saw palmetto root and leaves, finding from 4 to 6 per cent. in the root and a trace in the leaves.

MUCK.—Eighteen samples of muck, mainly to determine the percentage of ammonia; complete analyses of the ash of some were also made.

Besides the above analyses, I have made over fifty qualitative tests of limestones, marls, clays, kaolins and small grade phosphates.

NOTES ON INSECTICIDES.

BY J. J. EARLE, ASSISTANT CHEMIST.

Insecticides which contain arsenic are actively poisonous in the vegetable as well as in the animal kingdom, and should always be used with extreme care. As their value depends almost entirely upon the amount of arsenious acid (oxide) which they contain, it will be well to know the composition of some of the most common.

Arsenious Acid (oxide) is the ordinary white arsenic of commerce. It is a white impalpable powder which dissolves very slowly in cold water, one part of arsenious acid requiring about eighty parts of water for its complete solution.

Paris Green.—An analysis of this article gives:

Moisture at 212°	1.34	per cent.
Copper oxide	33.35	" "
Arsenious acid (oxide)	61.25	" "
Acetic acid	3.93	" "
Insoluble matter	0.13	" "

This was a very good sample. The article as found on the market varies considerably in the amount of arsenious acid which it contains. It is also often adulterated, failures in its use being no doubt due to this adulteration. Paris green is sparingly soluble in water.

London Purple is a waste product produced in the manufacture of the aniline dyes from coal tar. It contains on an average:

Calcium oxide (lime)	21.82	per cent.
Arsenious acid (oxide)	43.65	" "
Rosaniline	12.46	" "

The arsenious acid is combined with the lime to form arsenite of lime, which is insoluble in water, and with the rosaniline to form arsenite of rosaniline, which is completely soluble in water.

Experiments carried on at the North Carolina Agricultural Experiment Station show that the "blistering" or "burning" of the leaves and twigs of trees which have been sprayed with arsenical solutions is due entirely to the arsenious acid which had become soluble in water and that the injury was in every case proportionate to the amount of soluble arsenious acid, that is, the more the soluble arsenious acid, the greater the "blistering" and "burning." In no instance did injury result when all of the arsenious acid was in an insoluble form.

In this connection it would be well to know the relative solubility of arsenious oxide, Paris green and London purple in water. One pound of each were carefully mixed with one hundred gallons of water and tested for soluble arsenious acid after standing one hour and ten days respectively. The following results were obtained (Prof. Kilgore):

	Amount that went into solution in one hour.	Amount that went into solution in ten days.
Arsenious acid	$\frac{11}{1000}$ of 1 lb.	$\frac{900}{1000}$ of 1 lb.
Paris green	$\frac{12}{1000}$ of 1 lb.	$\frac{18}{1000}$ of 1 lb.
London purple	$\frac{114}{1000}$ of 1 lb.	$\frac{131}{1000}$ of 1 lb.

Knowing that the injury to the plant is proportionate to the arsenious acid soluble in water, we can easily see that in freshly made mixtures, London purple is far more injurious than either Paris green or arsenious acid, and that Paris green is slightly more injurious than arsenious acid. In mixtures that have stood several days, however, the arsenious acid, becoming almost entirely soluble, is far more dangerous than either the Paris green or London purple.

Solutions of Paris green and London purple can be safely used after standing, but those of arsenious acid should never be used except when freshly mixed.

USE OF LIME.

If a compound can be found which will combine with this poisonous arsenious acid, as fast as it becomes soluble in water, to form an insoluble compound, this objection to its use will be permanently displaced. Such a compound is *lime.* In solutions of arsenious acid and Paris green, caustic lime, or common lime of commerce, combines with the soluble arsenious acid to form the insoluble arsenite of lime, and in London purple it displaces the rosaniline in the soluble rosaniline arsenite to form the arsenite of lime. From one to two pounds of lime in solutions containing one pound of arsenious acid, London purple or Paris green in one hundred gallons of water is amply sufficient.

Numerous comparative tests have been made upon plants in various stages of growth with solutions of arsenious acid, Paris green and London purple, respectively, in water without the addition of any lime and with solutions of the same strength mixed with lime. In every instance in which no lime was used, the plants were more or less "blistered," and in no instance where it was used was there the least "blistering" of the plants. This is an important fact and should be carefully noted.

The following formula of arsenical solutions, partly taken from Bulletin 9, of this Station, will be useful:

London purple, Paris green: Thoroughly mix one pound of the poison with about one and one-half pounds of lime in two hundred gallons of water. Dissolve a little flour paste in the water to make it sticky; stir frequently. Applied to trees it is a sure cure for all insect plagues.

Arsenious acid or white arsenic: Boil one pound of white arsenic in about five gallons of water containing one and one-half pounds of lime (Prof. Kilgore); the arsenious acid is soluble in an excess of boiling water, but as fast as it goes into solution it combines with the lime to form the insoluble arsenite of lime After boiling thirty minutes allow to cool and make up to two hundred gallons with water containing flour paste. It will have the same value as the above formula.

Bordeaux mixture: This fungicide is prepared thus: One pound sulphate of copper (blue vitriol), dissolve in one vessel in one gallon of hot water, in another vessel one pound of lime is slaked in one and one-half gallons of cold water, and when cool pour into the copper solution and strain, add two gallons of water, and it is ready for use.

Solutions containing one pound of Paris green, London purple or arsenious acid in one to two hundred gallons of Bordeaux mixture can be used with perfect safety *without* the addition of lime, as the mixture contains enough lime to convert the soluble arsenious acid into an insoluble form. Such a solution will be valuable both as an insecticide and fungicide.

NOTE.—Credit is due Prof. Gillette, of the Iowa Station, and Prof. Kilgore, of the North Carolina Station, for the discovery of the valuable use of lime in insecticides containing arsenious acid.

FT. MYERS SUB-STATION.

PINEAPPLES.

By L. C. WASHBURN, M. D, Supt., Ft Myers, Fla.

The pineapple is one of the most delicious of all fruits. It is a native of the tropical parts of the American continent. It was first discovered in 1513 by Balboa, growing wild in Central America. It is a member of the Cactus family, with great tenacity of life. The slips may be left in the sunshine for a month and grow after being planted out. It is very hardy, will withstand a great deal of dry weather and a great amount of wet weather, yet is a shy bearer if improperly handled. It is propagated by means of suckers and slips, as the plant produces no seed. There is a little plant growing out of the crown of the fruit and a row of plants growing out of the summit of the stalk at the base of the fruit. These are slips and will ripen fruit in two years from planting out. From six to twelve slips may be expected from one stalk. The suckers are the little plants growing out of the stalk, usually near the ground. A pineapple plant is expected to produce from one to six suckers a year. The suckers will ripen fruit in one year or less after planting the same, as they will if left growing on the old stalk. The slips, if any difference, produce the finest specimens of fruit. The pineapple tree attains to a height of three to seven feet, according to the variety, climate, soil, etc. It is not an air plant as it has been improperly termed, as it will not grow nor reproduce itself in the air alone. Again, it is said that it will grow and produce as well on poor land as rich; which also is a mistake and has caused planters to lose both in money and time. On our poorest pine lands, without fertilizers, the trees will be small and the fruit weigh from one to two pounds each, while on the same lands, well fertilized, the trees will be strong and the fruit from twice to four times as large. This is a sun plant and does not do well if much shaded, but watermelons and cowpeas, planted so as to shade the ground, may be an advantage, if not permitted to cover up the pineapple plant itself. The thousands of islands around the peninsula of Florida are highly fertile and the pineapple does well upon all of them south of the 27th degree of North latitude. The piney woods of our main land here seem to be better adapted to the pineapple than any other known country. People that are engaged in the cultivation of the Red Spanish pineapples, in the Spanish American countries, can scarcely believe that those they see growing here are the same variety, being superior in size, succulence and flavor. The same rule, I think, would hold good for other varieties. We grow the Sugar Loaf, Prickly Cayenne, Queen, Moscow Queen, Ripley Queen, Lady Beatrice, Mount Serrat, Lambden, Porto Rico, Egyptian Queen and some other varieties. The pineapple must be planted out where you want it to stand, as it will do no good if transplanted. No trouble to get it to live, but it will stand from year to year and never make a tree or fruit. The authorities at Washington make a great mistake in planting out slips and suckers obtained from tropical countries before sending them to their destination. When the suckers and slips are received at Washington they should be sent at once to their destination, as they can be kept for months and then do well. Our land must be cleared of saw palmetto, pine trees, stumps and roots, at a cost of $40 per acre, as labor is high, and can be made ready for pineapple plants in two weeks. I would set the rows three feet apart, north and south, opened out, with two furrows. I would put well-rotted muck, marl, stable manure or sea grass freely in these trenches, and spade it up and mix well with the soil, pulled in from each side. I would set the plants out in these rows two feet apart (6,400 per acre). slightly below the level of the ground, and gradually hill up the plants as they grow, with a hoe. Never let a horse go through the field after having planted. If planted out with suckers hoe in fertilizers between the rows in six months, but if planted with slips hoe in fertilizers between the rows in one year, so the feeder roots can reach it. Cultivate shallow with a hoe and pull the grass from about the plants so as not to shake or jar them. Some growers put the slips 4x4 feet to secure large fruit, others plant out 18x18 inches all over the ground and claim better results. The pineapple will ratoon from year to year, but it is best to take them all up and replant with fresh slips after the fourth crop. Do not pull the short leaves from the base of the slip, as they help to hold the plant firmly in the soil. Planted out, with 6,400 slips per acre, an acre will ripen about 5,000 pineapples in two years. These will average over three pounds apiece of our smallest varieties, say eight tons of fruit per acre. The rest of the 6,400 plants will fruit later on and scattering, so there are ripe fruit in the field at all times.

The pineapples are worth about ten cents apiece here. If cultivated on a large scale the better plan would be to start a factory and chrystalize the fruit and work up the peelings into extract. The flavor of the pineapple is characteristic and its extract highly prized for use in soda fountains and the culinary department. It is claimed that $500 to $1,000, net proceeds, can be made each year from an acre of pineapples. This is one of our most healthful fruits and its juice is one of our best remedies for diphtheria and other forms of sore throat, being detergent and antiseptic.

Pineapple cider is made by putting the peeling of one pineapple into two quarts of sweetened water and it is ready for use in twenty-four to forty-eight hours—a pleasant, healthful beverage for sick or well, the equal of the best apple cider.

Pineapple wine is the equal, if not better, than any made from grapes for all purposes.

This favorite fruit can be grown in this part of South Florida to supply the United States with its increasing demands, and is destined to become one of Florida's great industries. It is well to sprinkle cottonseed meal on the young plants once in two months, as it forms a coating and prevents the plants from being injured by sand. There are no known enemies to the growing pineapple here, but rats, raccoons and opossums will eat the ripe fruit if permitted. Pineapples grown in Florida, from some cause, are proven to be superior in size and quality to those produced in other countries. They are like the orange in this respect. Our growers here sell pineapple slips at $5 per 1,000, and suckers at $10 per 1,000 at the farm, and an extra charge if required to deliver them. Plant any time of the year. From August to March is probably the best.

FORMULAS.

No. 1.—ARSENITES.—LIQUID.

Paris green or London purple	1 pound.
Flour or starch cooked into a paste with water	5 pounds.
Hard-water	150 to 250 gallons.

Directions.—Stir the arsenite into the water, then add the paste, and thoroughly mix. Apply with a sprinkler or spraying-pump.

DISCUSSION.—This is the standard treatment for all gnawing "worms" and bugs. Instead of the flour, one pint of liquid may be added to each 150 gallons of water. The use of the flour or glue is to make the poison adhere better to the foliage. When no adhesive material is employed, the poison is completely washed off by the first rain. Instead of water, the *"Bordeaux Mixture" may be used. This will protect the plants from both insects and fungus pests. Only the weakest solution should be used on the peach and plum trees.

No. 2.—ARSENITES.—POWDER.

Paris green or London purple	1 pound.
Flour	10 pounds.
Road-dust, lime or coal ashes	20 pounds.

Directions.—Mix the arsenite with the other substances. Apply with a bellows, bag or sieve.

Discussion.—In this formula the flour is used for its adhesiveness; the dust, lime or ashes as a dilutent only. Wood-ashes are not so good as coal-ashes, since the potash contained in wood-ashes is like to render the arsenic more or less soluble. The coal-ashes must be sifted and only the finer part used, and should be as dry as possible. This compound may be applied by a bellows, or it may be sifted on the plants with a common seive or from a tin-bucket having the bottom perforated with fine holes, or from a bag of thin or coarse cloth. On a large scale, Paris green has been used dry for poisoning cotton caterpillars without dilution.

No. 3.—KEROSENE EMULSION.

(A.—COOK'S FORMULA.)

Soft Soap	1 quart.
Water	2 quarts.
Kerosene Oil	1 pint.

Directions.—Boil the soap in the water until entirely dissolved. Remove from fire and add the kerosene. Churn the soap solution and oil for ten minutes, or until *thoroughly* emulsified, or force the oil and soap through a spraying pump three or four times, spraying it back into the same vessel. When properly done the oil will not separate from the soap after cooling. One-fourth pound of hard soap may be used instead of a quart of soft soap. Dilute the emulsion with its bulk of cold water before using.

(B.—RILEY'S FORMULA.)

Hard Soap	½ pound.
Water	1 gallon.
Kerosene Oil	2 gallons.

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*BORDEAUX MIXTURE.

Copper Sulphate (Bluestone)	4 pounds.
Unslaked Lime	4 pounds.
Water	22 gallons.

Directions.—Dissolve the bluestone in sixteen gallons of water, using a glass, wooden or earthen vessel. In another vessel slake the lime in six gallons of water, then strain the lime and stir it slowly into the bluestone solution. It is then ready for use.

Directions.—Boil the soap in the water until all dissolved. Remove from fire and add the oil. Churn for ten minutes or spray back into the vessel until thoroughly emulsified. Dilute with nine parts of cold water to one of the emulsion before using.

Discussion.—These two formulas are about equally effective, but the (A) formula is easier prepared and will be the one most frequently used by farmers. This is the best of all remedies for plant-lice and soft, smooth "worms," while they are young.

No. 4.—KEROSENE OINTMENT.

Lard	1 pound.
Sulphur (powdered)	2 ounces.
Kerosene Oil	½ pint.

Directions.—Mix the lard and sulphur, then add the oil. Keep in a tightly closed can. Apply by rubbing.

Discussion.—Formula No. 4 is chiefly valuable for killing lice on poultry and domestic animals.

No. 5.—CARBOLIC ACID EMULSION.

Soft Soap	1 quart.
Water	1 quart.
Crude Carbolic Acid	1 pint.

Directions.—Make into emulsion as directed by formula No. 3. Before using dilute with one-half its volume of cold water. Apply with a stiff brush.

Discussion.—Formula No. 5 is highly recommended for cleansing apple and other fruit trees infested by scale and bark lice, and for smearing the base of the trunk to protect from the borer. Should not be applied to the foliage.

No. 6.—POTASH SOAP.

Potash Lye (concentrated)	1 pound.
Fish Oil or Cotton-seed Oil	3 pints.
Soft Water	3 gallons.

Directions.—Boil the lye in the water until all dissolved. Then add the oil and boil for two hours. Replace evaporated water with hot water from time to time. After two hours of boiling remove from fire. When cold the soap should be solid and may be cut with a knife. Use one pound of this soap to eight or ten gallons of hot water. Spray upon lice infested plants and trees, or rub on branches with a stiff brush or with the hand.

Discussion.—The potash soap has been highly recommended for plant lice, and is easily and cheaply made. The liquid as applied to the plants costs about fifteen cents to 100 gallons. The soap may be made in winter while other work is slack and will keep for any length of time.

No. 7.—TOBACCO DECOCTION.

Tobacco Stems or Tobacco Dust	1 pound.
Water	3 gallons.

Directions.—Place the tobacco in the water and boil for one half hour. Remove from fire and let stand, covered, until cool. Use without dilution as a wash or spray. The liquid may be made when convenient, and stored away in bottles or casks, which must be tightly closed.

DISCUSSION.—Formula No. 7 is recommended for use against the flea-beetle, cucumber-beetle and plant lice. It is especially valuable for use in conservatories and on house plants. May be applied with a syringe and is an excellent fertilizer for plants. It may be used to rid animals of lice, instead of the kerosene ointment.

No. 8.—PYRETHRUM.—DECOCTION.

Pyrethrum Powder or "Buhach" . .	1 tablespoonful.
Water	2 gallons.

Directions.—Stir the powder into boiling water and use immediately. Apply with a spraying pump, syringe or sprinkler.

DISCUSSION.—Pyrethrum may be applied either wet or dry. When used dry, the pure powder is blown upon infested plants with a bellows. The wet way seems to give most satisfaction. This powder is very apt to lose its power when kept any length of time and is in general very unreliable.

No. 9.—WHITE HELLEBORE.

Hellebore powder is always used pure. May be used as a decoction or dry powder as directed for Pyrethrum.

DISCUSSION.—Hellebore powder is the best remedy for the "worms" which attack the currant and gooseberry.

No. 10.—BISULPHIDE OF CARBON.

DISCUSSION.—This substance is a clear, badly-smelling liquid, and is always used pure and undiluted. It is the best thing for killing the weevils in beans, peas, etc., and the insects which infest cereal grains. It will also kill or drive away ants, gophers and burrowing vermin, if poured into their holes and the opening stopped up. Bisulphide of carbon is very inflammable, and is poisonous when breathed, and, therefore, great care must be exercised in using it. It should never be used in an artificially lighted or heated room.

I do not know that I could give the readers of this bulletin more valuable information at this time than the formulas from Bulletin 78 of the North Carolina Experiment Station.

J. P. DEPASS, Director.

BULLETIN 15

OF THE

EXPERIMENT STATION

OF FLORIDA,

AT THE

STATE AGRICULTURAL COLLEGE,

LAKE CITY, FLA.

TOBACCO AND ITS CULTIVATION.

October 1st, 1891.

REV. JAS. P. DEPASS, DIRECTOR.

PALATKA, FLA.:
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1891

TOBACCO.

The experiment in Tobacco was conducted mainly for the purpose of studying the enemies of the plant, from the seed bed to the gathering of the crop, and the cheapest and best method of destroying them.

In this bulletin, however, we will discuss the following points in their order :

1st. The time of sowing.
2d. The preparation of seed beds. The character of land to select.
3d. The preparation of field. Fertilizing.
4th. Transplanting.
5th. Cultivation. Sprouting.
6th. Protecting against insects.
7th. Harvesting the crop. The curing shed or barn.
8th. Preparing for market.
9th. Bulking the crop.
10th. The year's experiments.
11th. Remarks.

1st. THE TIME TO PLANT.

It is conceded that as early as it is possible to get a bed of plants ready to transplant after the season of frosts should be the aim of every grower. Early plants grow off well, and the first crop is not so subject to enemies as when planted late ; will give more time for suckering, thus increasing the production and bringing the crop earlier in the year on the market.

I have found that the superstitious month with some for the first sowing of seed was January, and the day of the month the 7th. Of course no practical and sensible man will be influenced by such superstitions, however strongly urged by the old and experienced tobacco grower.

Tobacco seed can be sown in this section any day from the 1st of January to the last week in June. I have sown early in December, and by protection had plants ready for the field by the middle of January. It is, however, an exceptional year when such plants, if transplanted, are not destroyed by frost. This year I sowed February 11th and again on March 12th, and by the 25th of April the plants were ready to transplant. It was from the latter sowing I obtained plants, the first being destroyed by the flea beetle.

Before sowing

THE PREPARATION OF THE SEED BED

should have special attention.

New or fresh land is the best, but not a necessity, for the seed bed. To those who have the land and time and means to prepare it. new land has some advantages; but old land properly prepared will answer all purposes and it is much cheaper to use it. The question of burning land is also a doubtful one. I tried both burnt and unburnt lands this year and the unburnt lands gave the best results by odds. I fertilized the unburnt, however, but did not the plats on which the burning was done. But the demonstration was clear that this year as well as the last beds sowed on unburnt lands produced strong, stocky and healthy plants.

Burning brush on either old or new land is costly. It is contended in its favor that it—

1st. Kills grass seed.
2d. Destroys destructive insects and worms, which will prey on the plants.
3d. It enriches the soil.

Experience teaches that on fresh land on the station the beds which were burnt were not freer from grass or weeds, nor from destructive insects, nor that the soil was in better condition than the unburnt when the latter was fertilized. Old land treated the same way gave, within the past two years, similar results. If unburnt old land is treated for insects (as see below), and it is not a demonstration that it has more insects than new land, for it is my opinion new land should be treated the same way, then this advantage of the new over the old is not demonstrated in this respect. It is the custom of some farmers to fertilize new land after it is burnt. I concede that it ought to be done, since doubtless this was the reason of my failure in plants on new land burnt but unfertilized.

I would suggest that each planter try both plans on both old and new land and demonstrate the better way for himself. Surely if old land can be utilized as a seed bed, with or without burning, it will very greatly cheapen the production of tobacco, especially when the acreage planted is a large one.

The bed, whether burnt or unburnt, should be prepared at least one month before the seed are sowed. To do this select a moist plot of ground that is well drained, with sun exposure. Break it up deep and pulverize the soil. Then broadcast the fertilizer and harrow or rake it in. Let the bed remain for a month, when harrow it again, lay off rows six inches apart, the furrow must be very shallow, sow seed, cover with hand and roll with hand roller, or press the dirt to seed by hand. Too much stress cannot be laid on the necessity of manuring several weeks before sowing seed, because the heat which manure passes through when put in the ground will destroy the germ. I knew an acre thus killed out entirely by chicken house manure, which was placed in the ground one day and sowed the next.

A tobacco seed bed ought to be handy to water, so that the bed may be sprayed or sprinkled every evening with enough water to prevent the drying out of the seed or plants during a dry season. Sandy soil dries rapidly to the depth which seed ought to be planted, and if the seed germinate and have not sufficient water to keep them alive, they easily die before seeing the sun. In watering seed bed, care should be taken not to make a crust so hard through which the tender plant cannot force its way. This is one reason why I urge the planting in rows, as preferable to broadcasting; it permits the watering of beds before seed are up, and when the plants are just up, besides if grass or weeds show themselves later on they are easier managed.

Before sowing the seed, as a protection against the flea beetle and other insects that may destroy the plants, the bed ought to be thoroughly sprayed or watered with a decoction made by mixing 1 oz. of Paris green with 15 or 20 gallons of weak soap suds.

After the plants show themselves, the same can be used. It would be better, however, to mix 1 oz. of Paris green in 20 gallons of hard water, and spray the plants with it. Hard water is made by mixing lime in water and allowing the lime to settle before using it. Two pounds of lime to 20 gallons of water, well mixed, would be a proper proportion. Pyrethrum (insect powder) may be used in the place of arsenic or Paris green, either dry or in decoction, but it is not so good, besides it is costlier and as bought from the stores is unreliable being too generally adulterated.

The seed bed is an absolute necessity to a crop of tobacco. Here is where the greatest care should be taken to protect against failure. I have had bed after bed of plants ruined by the flea beetle, attributing the failure of plants to bad seed. This year this destructive insect performed its work as last year in the early sowings, and after finding it in the bed and knowing it was the cause of failure. I began experiments for its destruction. When the beetle was conquered the plants grew. I have known farmers to lose their entire crop because of the failure of the seed bed, doubtless on account of this insect, when they attributed it to poor seed. Tobacco seed being very small and the germ very small, a very small insect can do it permanent damage. The beetle attacks the plant from the time it germinates until it is large enough to transplant. There are some soils not infested with it, and when such is the case it is not necessary to provide against it. But those who do not know this, in my judgement, would act wisely by working against it, or at least by being prepared for it, since the remedy is cheap, so that if it is observed immediate measures may be taken for its destruction.

The amount of seed commonly estimated to plant an acre is one teaspoonfull, sowed on a bed twenty feet square. To insure against failure I would advise the grower to procure a larger amount of seed per acre by four or five times, to sow a larger area, and make two or three sowings at intervals of from two to four weeks.

The seed bed, if planted on the slope of a hill, should have the rows running up and down the slope and not transversely, with a drain on the upper side to turn the water from above, for this will enable the water in a heavy rainfall to run off without damaging the bed so much.

The protection against exceptional cold spells should be taken into consideration when laying off the beds. A high, cold wind from the North or North-west and North-east is very destructive to plants in bed, while a frost enforces another sowing unless due protection is provided. A cheap protection against frosts, if not the cheapest, is an awning made out of cheese cloth, stretched over the beds and secured to corner posts, two feet high. If a cold wind is blowing the whole bed and sides should be covered.

A bed can be fertilized with well decomposed stable or cow manure. It must be made very rich. A cow pen well tramped would serve a good purpose, also a hog pen and cotton seed with germ killed and well rotted, cotton seed meal and fowl house manure. The Station composts, No. 1 and 2, have been found good. These must be used according to the character of the soil. If the soil is poor, at the rate of from 2 to 4 tons of the compost should be used per acre: of cotton seed meal from 1 to 2 tons; cotton seed, from 1 to 3 tons, and stable and cow manure, from 10 to 20 tons.

THE CHARACTER OF LAND TO SELECT

on which to grow tobacco in Florida is light, sandy loam, with or without clay subsoil, that is, neither too wet or too dry. A clay soil does not make good tobacco. Wet land well drained, is best adapted to its growth. New land needs less manure than old, but the leaf is heavier and coarser. Light sandy land makes the lightest leaf and the finest wrapper.

It is a common statement that land where the lime rock abounds, or what is termed the rotten limestone lands, is not adapted to the plant. This is a mistake. The simple fact is that there is but little land in the State where cotton and corn are cultivated but what will raise tobacco profitably.

The Preparation of the Field

is of the greatest importance. The land should be broken up in January and harrowed if turfy. Three weeks at least before transplanting, old land should be laid off in furrows —it is not necessary to treat new land thus if not fertilized— three or four feet apart, according to its fertility, and the fertilizer placed in rows and covered. In covering fertilizer, either the foot or hoe should be used, and then only the manure covered, which should be dropped from eighteen to twenty-four inches apart in furrow. This leaves a small bed, which marks the place for the plant and gives the manure time to pass through a heat and thus prevent its killing the plant when put in.

Transplanting

tobacco plants is as easily done as cabbage plants, and in the same way. They live as readily and the same rule governing the one will hold good for the other. There should be droppers and planters, the planter always carrying a few plants in order to supply the places which a careless dropper may miss. It greatly facilitates the growth of the plant to have the planter followed by one who will pour a little water on each plant after being set to pack the earth around the roots. Even if the season is a good one, this is a good plan but not thought to be necessary, if the ground is wet and rain is expected. If the plants are ready and the season dry, watering is necessary. It is a matter of great economy to get the plants out as early in the season as possible, because the sooner the plant begins to grow, the earlier the work begins and the more readily will grass and weeds be subdued, besides the worms which eat the leaf will not be so destructive on first and second crops. The plants are ready to transplant when they have four leaves, although they may be flat on the ground. If the ground, however, is very dry, it does not hurt to wait for a season, even if the plant grows to six or twelve inches high. I planted out a small plot this year in a dry season without watering, when the plants were from fifteen to eighteen inches high, putting them but little deeper than they were in the seed bed. While they did not do as well as when smaller in a fair season, still, as will be seen below, they made a fair crop. A gentleman of this, Columbia County, Mr. Wm. T. Henry, a successful tobacco grower, tells me that he succeeds as well with large plants as small and medium sized ones by planting them in the ground so deep as to leave the bud and a few leaves out. His experience is that the stock puts out latteral roots and the plant makes as much and as good tobacco. A few days after transplanting, the patch in field should be gone over and where a plant has failed to live, another should be put in its place.

THE CULTIVATION

of the field should commence as soon as the plants are set. A Planet Junior cultivator run between the rows will break or loosen up the soil and thus prevent evaporation of moisture. Care should be taken not to run too close the plant and cover it with dirt. The grass and weeds must be kept down, and for this purpose the cultivator and hoe will be necessasy. In cultivating tobacco, deep plowing is an injury, as also is the bedding of too much dirt to the plant. Tobacco does not require as much work as cotton, because it grows more rapidly, shades the ground sooner and matures quicker. The natural tendency of tobacco is to put out sprouts at each leaf. These, when one or two inches long, must be pinched off close to the stock and not allowed to grow. This is called

SPROUTING.

By allowing these to grow they dwarf the leaf, which is the valuable part of the tobacco. By keeping the sprouts down the strength of the plant is thrown in the leaf, which makes them broad and large. Another point to be carefully watched is to prevent the plant from running to seed. To accomplish this, as soon as the plant begins to bloom or shows a tendency to do so, it must be stopped, unless you wish to make seed and not leaf. Usually the plant is topped when it has from ten to fourteen leaves. The tobacco plant is very tender and brittle and the sprouting and topping can be easily done by simply pinching them off with the thumb and forefinger.

THE ENEMIES

of tobacco are very destructive. The cut-worm begins its work on the plant as soon as it is transplanted, and this destructive worm often does its work to the plant in the seed bed. The spraying recommended for the flea beetle will serve as a good protection against them. In the field, however, it has been found that Paris green mixed with common flour, in the ratio of an ounce to four or five pounds, and sprinkled around and on the plants, will, to a great extent, destroy this worm. A perforated tin box, such as a mustard box, or any other can will serve the purpose of distributing the poison.

The bud worm is very justly dreaded, because its work is very destructive. It is a small worm, comparatively, that eats into the bud of the plant, doing great damage to the leaves. This pest can be largely controlled by sprinkling in the bud from time to time arsenic or Paris green in the same proportions as for the cut worm and prepared in the same way.

The horn worm is very large and very destructive to the leaf. The fly lays its eggs in the night upon the leaf. These worms after hatching grow very rapidly. The best method and the only one used is to pick off the worm and eggs at regular periods. It is estimated that a patch or field should be wormed every other day. If the season is propitious they multiply very rapidly, and this worm with the bud worm are the enemies which injure the plant after it begins to grow to any size, and they should be very carefully hunted.

Spraying the leaves of tobacco with any poison or dusting it for the purpose of killing the horn worm is said to injure the texture of the leaf and also the flavor of the tobacco. If arsenic kills the bud worm, which sometimes destroys the bud and always injures the leaves in the growing plant, it is possible that spraying may not have a damaging effect. This, like many other current opinions, not having been tested, may be false. That the worm can be destroyed by spraying and thus largely cheapen the labor of making tobacco, is beyond a question. But if the leaf and quality of tobacco is injured thereby it would be folly to do it. But as the matter has not been settled as to the iujury of tobacco if sprayed, it will be a part of the Station work next year to make experiments on this line.

THE FRIENDS.

The tobacco grower has very valuable friends in the hornet, the wasp, the dirt-dauber and this class of insects. These feed on the bud and horn worm and some years are very valuable, rendering the work of worming very light. These insect friends were of great service on the Station this year and also in this county. Their value to the farmer generally in destroying pests cannot easily be estimated, and it is well for farmers generally to know that instead of trying to destroy them they should have them protected not only for the sake of tobacco but other crops.

Mr. Geo. C. Mattox, of this county, a successful farmer and tobacco grower, states that cow peas planted around the tobacco field attracts the wasps to the tobacco. This is worthy of trial, especially with small planters, for anything of this kind, which will encourage these insects is worth the labor.

HARVESTING

is very irregular. From the time it begins until the crop is gathered, it is daily work. This work embraces the period from the first ripening to the last. Tobacco begins to ripen from six weeks to two months after being transplanted. After the first crop is gathered the plant puts out suckers and it will sucker from three to four times, provided it is planted early enough, thus making as many crops in a season.

The best way to harvest is to gather the entire stock when ripe by cutting it off near the ground with a sharp knife. This should be done by bending with left hand and cutting from below up. The leaves should not be stripped from the stalk. Care should be taken not to allow sand to get on the leaves, as it very generally injures the sale of the crop. By cutting off close to the ground the plant begins at once to put out suckers. All should be pinched off except one, and it should be treated as the original plant. The third and fourth crop should be treated in the same way. The fourth crop is a small one but the leaves serve as a filler or for smoking tobacco, and if gathered it makes an excellent fertilizer. The stalks should all be saved for this purpose and are valuable with which to mulch fruit trees. It will very greatly increase the third and fourth crop if cotton seed meal is worked around the plant after the second cutting or even the first. The great trouble with inexperienced growers is to determine when the tobacco is ripe. Experience, however, soon settles this matter and it is not difficult to learn. The novice ought not to be deterred from planting because of the want of this knowledge. Color of leaves does not prove the best rule to determine the ripeness of the plant, although when the leaves begin to lighten in color or spotted it is a good sign. A better rule is that when the top leaves between the stems will readily snap in the fingers.

THE CURING SHED OR BARN

may or may not be a costly building in our climate. For those who are beginners it is not necessary to build a barn especially for the purpose if there is a gin house on the premises or a log house that can be used. I have seen the very best quality of tobacco cured in a log house, the joists of which were not six feet above the floor. A common wagon shed will serve the purpose to begin with, if closed on the sides by rough-edge boards. The tobacco crop of the Station is cured in the upper part of a wagon and tool house. A great many persons will doubtless begin the cultivation of tobacco by planting from one-half to five acres. In their interest the above is written. For those who are determined to make it their business and who wish to build barns they can do so cheaply with rough lumber.

The points to be observed are ventilation when needed and the shutting it off. There should be doors at each end of the barn large enough to drive a wagon through. There is no necessity for a wooden floor, but the sills ought to be laid on brick or rock in our climate to prevent rotting and the space between the sills and the ground closed with plank. Frames from the top to the bottom should be built inside on which to place poles or laths on which to hang the tobacco to dry. A sharp hollow spear that will fit a lath, made sharp enough to pierce through the stalk should be used. The stalk pierced and slipped on the lath or small pole and repeated until the pole is full, not allowing the leaves to touch each other and then put in place on the frames, is the cheapest, easiest and most expeditious way of hanging tobacco in the barnes. It, however, may be tied by strings to a pole, or with a knife a slit may be cnt in the stalk and one end of the small pole or lath may be sharpened and pushed through but these methods are both costly and tedious. Care should be taken to economize all the space possible and the number of stalks to each lath or pole is to be settled by the distance of frames apart on which they are to rest. A shed 30 by 60 feet and from 10 to 14 feet high is sufficiently roomy to cure five or six acres of tobacco. Persons who desire to build fancy barns can do so, keeping in view the necessity of ventilation both above and below.

PREPARING THE CROP FOR MARKET.

The leaves are ready to strip from the stalk when the stems are sufficiently dry as to show no sap when pinched. Before stripping, however, the leaves should be moist enough so that they will not crumble or break in handling. If the weather is dry the tobacco becomes very dry, but by giving it ventilation at night by opening doors and windows, or during a rain, the condition can be obtained for handling.

In assorting those which are ragged, the top and bottom leaves should be put to themselves and tied into bundles ranging in number from twenty-five to fifty according to size. These are for fillers. The better leaves should be assorted according to size and tied in bundles or hands from twenty to thirty in each. These are for wrappers. In stripping tobacco the leaves should not be smoothed out by the hand, but put into bundles just as they are on the stalk.

The different grades should never be mixed in packing, but kept to themselves. In packing into boxes or bales the tips should lap each other and care should be taken to pack firmly and evenly. The ends of the packages should not touch the box sides, for ventilation is needed here to some extent to prevent moulding. When boxed keep on a board floor and under no circumstances allow the box or package to remain on the ground. The boxes should be as light as possible and uniform in size, but the dry goods boxes of merchants serve an excellent purpose.

Bulking the Crop.

I mean by bulking that the farmers of a county would, I think, find it to their interest to store their crop in their county town for assortment and sale, securing or building a house for this purpose. An expert should be employed who will carefully assort and bale the tobacco in the same way as the Cubans do. Wrappers, binders and fillers should be packed to themselves. In this way the crop would realize more money, amply repaying the cost of expert. On this line much could be said.

This Year's Experiment

was not begun with the view of estimating the amount of tobacco that could be made per acre, still below I give results on this line, but as stated, in order to study the enemies of the crop. In the foregoing pages my experience is given in regard to them.

The season was unusually dry and in transplanting and afterwards, the patches on the hillsides had to be watered some.

Three plots were planted ; one on fresh bottom land, unmanured, containing 7,225 square feet. This was the richest and in every way best adapted to tobacco. The yield per plot was 125 pounds and per acre at the rate of over 750 pounds.

The second plot was on a dry hill-side and old land. This plot was replanted several times and watered before a stand was obtained. The yield was 75 pounds to the plot, consisting of 8,360 square feet, or per acre in round nnmbers 400 pounds.

The third plot consisted of tiled land on slope of hill and planted several years in vegetables, in early spring this year in green peas. After the peas were removed tobacco plants averaging from 15 to 18 inches high were planted, the object being to place them in the ground as deep as they were in seed bed. The spectacle presented a few days afterwards was very discouraging and reminded one of a tomato patch planted in dry weather with same size plants. Many of the lower leaves dropped off; the top wilted down almost half way to the ground and every indication of failure and death was apparent. In a few days, however, the plants straightened up, new leaves began to grow, and the plot consisting of 7,200 square feet, less than one-sixth of an acre, yielded 75 pounds or over 450 pounds per acre.

The hill-side and tiled plots were fertilized with Station compost No. 1 at the rate of 2,000 pounds per acre. The crop was cultivated with Planet Jr. cultivator and hoe until the ground was shaded, and the grass and weeds kept down in same way with each successive crop.

Remarks.

The experiment last year in tobacco was made on a cabbage patch, the plants put in the hills after the cabbage was cut. Thosewho grow vegetables will be able to utilize their land in a tobacco crop and get it off before it is time to prepare land for vegetables in the fall.

The later tobacco is planted in the field the more liable is it to be injured by insects. The crop planted last year, when seed was sowed as late as June 19th and plants set out as late as July 12th, the insects were very troublesome. If these pests can be controlled late in the season, Florida gardeners in the tobacco crop have an industry of very great profit to them. The harvesting of this late planting began the middle of September. Cigars made from this tobacco tested by experts in one of the largest factories in the State were said to be as good as any raised in Cuba, except the Vuelta Abajo.

Chickens, turkeys and guineas are useful to worm the crop, and where they can be given the use of the patch they will do good work for the small farmer.

Seed.

The Board of Trustees has authorized me to purchase fifty dollars' worth of seed for free distribution to those who desire to cultivate tobacco. I have, through Mr. F. S. Yznaga, who is connected with the celebrated manufactory of Havana cigars of V. Martinez, Ybor & Co., Tampa, Fla., made arrangements to have them purchased fresh in Cuba. If I succeed in securing them I will distribute as much as an ounce to each applicant as long as they last. The seed to be purchased will be the Vuelta Abajo, conceded to be the finest variety raised. I would suggest to the farmers of each county to settle on one kind of seed and uniformly work together to make their county famous as to the character of their tobacco. In this way every advantage there is in soil, climate, curing and handling is secured, and if the crop of the county is bulked, assorted and packed, it would be but a short while before each county would have established a special character and brand that would largely increase its profits. Farmers testing various kinds of seeds, at the same time will doubtless get the tobacco mixed and this will surely injure its sale.

It is my purpose on the Station and its sub-stations to test various kinds of seeds from different countries, if they can be obtained, in order to settle, if possible, which will produce the best wrapper.

The Vuelta Abajo makes the best filler and a good wrapper. As wrappers bring the highest prices, to raise them is the first consideration. Various opinions obtain as to whether seed from this or that country will make the finest and highest-priced wrapper. This the Station in due time hopes to be able deffinitely to settle.

JAS. P. DEPASS,
Director.

BULLETIN No. 16

—OF THE—

EXPERIMENT STATION

OF FLORIDA,

—AT THE—

STATE AGRICULTURAL COLLEGE,

Lake City, Florida.

Corn, Hay, Weevil, Rice, Cane, Texas Blue Grass and Cotton

JANUARY 1ST, 1892.

REV. JAS. P. DEPASS, DIRECTOR.

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CORN EXPERIMENT.

The experiment this year was with the object in view of testing, on a large scale on old land, the value of manuring. The fertilizers used were station compost No. 1 and No. 2. The station compost No. 1 was selected, because in the small plots of one-fifth of an acre planted last year, when different fertilizers were tried, the largest yield, according to cost of fertilizers, was in its favor.

Compost No. 2 was made with the object in view of testing the effect of iron on the soil, especially on a piece of land where the natural flow of water in heavy rains seemed to have washed away the top soil, and also on land of equal strength where compost No. 1 was used. The results will be seen below, with other notes and observations.

I had also the object in view of testing the difference between drilled and checked corn. But in this I am to some extent disappointed, since the order as to distance the drilled corn should have in row was likely misunderstood, as it was not executed as directed.

The year has been a singular one in this, that during the growing and making period the station suffered from longer droughts and less rain than in three years.

Each plot was prepared and cultivated the same way, with this difference only, that checked corn was cross-plowed.

Seventeen acres were prepared by breaking it up with a one-horse plow, then laid off, fertilized and planted. The seed were covered with a small bull-tongue. Planting began on the 24th of March.

From April 6th to 10th the plots were harrowed with a sharp-tooth harrow just as the corn began to break the ground, across the rows, leveling the ridges that had been made by covering seed.

The harrowing is quickly done, and has the effect of loosening up the soil, breaking clods, tearing undecayed grass from the plant, killing what grass seed may have begun to germinate, but does not injure the corn. It is equivalent to a thorough working.

In both drill and hill the seed were dropped thick, in order to secure a good stand. In this, however, I was disappointed, for, in consequence of dry weather, every plot had to be replanted.

The crop was worked with Planet Junior cultivator, receiving its first cultivation April 20. Following the cultivator, replanting was done with hoes. The second working began the 2d of May, twelve days after the first. It was the intention to work the crop three times, and every twelve days before laying it by. It had three, but the third began the 19th of May, seventeen days after.

Plot first, on old land, both hillside and bottom, was drilled and fertilized with station compost No. 1, one ton per acre. There was an average of sixty-eight missing and barren stalks to the acre on this plot and all the rest. The intention was to give the corn two feet distance in the drill, as it was also in other plots so planted, but in thinning it the average was over three feet.

The yield per acre on hillside was 22¼ bushels, and on bottom land 26 bushels. The stalk grew tall, and eared well, many having two fair ears of corn.

The second plot was old land, with the exception of a small strip of new bottom. Fertilized with compost No. 1, one ton per acre, and checked 4x4 feet. Yield per acre on hillside, 21 1-9 bushels; on bottom, 27¼ bushels.

Plot 3 was land on which last year one ton of compost No. 1 was used, and on which the corn was a failure, not making eight bushels to the acre, and the grain, as well as the ear, very inferior. Seed planted in 4x4 checks. To test the value of iron in fertilizer I used 1,700 pounds of compost No. 2 to the acre. (See for formula bulletin 14.) The yield was 21½ bushels.

Plot 4 was same quality of land as plots 1 and 2. Seed planted in drill, and thinned as in plot 1, and fertilized with 1,700 pounds of compost No. 2. Hillside yielded 28 bushels, and bottom 31 bushels and 3 quarts.

Plot 5 was fresh bottom land, unfertilized, and planted April 1st. The yield was 27½ bushels per acre. The average yield of the old land, according to season, is from 8 to 10 bushels per acre.

The cost of fertilizer No 1 is $4.66 per acre, and No. 2, $7.30.

OBSERVATIONS.

(*a*) The first plot was planted last year in cotton, and the two years previously in corn.

The second plot was planted last year in corn, and the year before in cotton.

Plots 3 and 4 were planted last year in corn, and the two years before in Irish potatoes, corn and melons.

The corn crop on hillside of plots 2, 3 and 4, last year, were fertilized with compost No. 1. The bottoms were planted in ensilage corn.

(*b*) It will be observed that there is but a little advantage in yield in drilled corn over check. It is possible, however, that the difference would have been more noticeable had the drilled corn been thinned to a closer stand.

(*c*) The improvement in the yield of the poor plot this year over last in the use of compost No. 2, in which there was iron, is very marked.

(*d*) In plot 4, where compost No. 2 is used on drilled corn, the yield over plot No. 1 is sufficiently striking as to attract attention, when it is considered that the quality of the land is as nearly equal as can be determined by the eye and its general products in common crops.

For some years I have been under the impression that much of our Florida soil, such as high, sandy pine lands, was lacking in iron. Observing the probable effect on plot 3, occasioned doubtless by the washing of rains, I determined to apply it. The results are encouraging I also used it on soil contiguous, but uniformly as good as any old land on the station, and it appears that some advantage resulted from its use.

(*e*) The pulling of fodder, as to its effect on the grain and the yield, was tried again this year. On 21st of July, late for pulling fodder by two weeks, one-tenth of an acre of bottom land, where the fodder was drier, but thicker and heavier, was pulled. It weighed 69½ pounds, or 695 pounds per acre. On hillside, where fodder was greener but thinner, the weight was only 46½ pounds, or 465 pounds per acre.

The yield of corn on this plot was 2 bushels, 3 pecks and 4½ quarts. Alongside of it the same sized plot, with fodder not pulled, yielded 3 bushels, 3½ quarts. The weight of corn on plot where fodder was pulled was 165½ pounds; on unpulled, 176½ pounds; a difference of 11 pounds. In measurement there is a difference of 9 quarts. In an acre the difference in weight would be 110 pounds, and by measure 90 quarts in favor of the plot on which the fodder was not pulled. On unpulled land, corn per acre by measure was 31 bushels and 3 quarts. On plot where fodder was pulled the yield per acre was 28¾ bushels and 5 quarts. Thus, by calculation, a difference in the weight of corn would be very nearly 3 pounds per bushel. Now, when the weight of fodder pulled as late as July 21st is considered in reference to its weight, the cost of pulling and its value as forage, and the loss of corn both in weight and bulk, it is a question whether it pays to pull it. On August

3d two other plots were pulled, but the fodder was worthless. The yield, however, on bottom was 29 pounds, and on hill 26¾ pounds, but the corn was not injured. Now, if this pulling had been done earlier by two weeks, while there would have been a gain in weight of fodder, possibly but not certainly, there would have been a greater loss in quality, bulk and weight of corn. Two years ago (see Bulletin 7) ten acres of fodder was pulled, weighing 1,317 pounds, when the yield of corn was from 13 to 32½ bushels per acre. The land was more highly fertilized than this year, and with costlier manures. The pulling was at that period when it is said to be "ripe." (Note: I use the term "pulling" because it is the Florida term. In other sections it is both called "stripping" and ' topping.")

(*f*) An evil attending fodder pulling is that, occurring at the time it does, and even as late as I pulled this year, July 21st, it exposes the ear to the sun, and causes the shuck to dry and loosen on the ear, thus giving the weevil (the bane of raising corn in Florida) a better opportunity of depositing its eggs in the corn. But to this I will refer further on.

(*g*) The seed corn of this year was gathered from the stalks of last year's crop, which had two or more ears on them. This was done for the purpose of observing the effect it would have upon the crop in producing more ears than one to the stalk, and thus, if possible, increasing the yield per acre. The whole crop was planted with this seed, and, with the exception of the replant, was made with them.

It was observed that this year there was a large increase in the number of stalks that bore two ears and more, some having as many as four. One hundred ears from single-ear stalks measured one bushel. One hundred ears were then measured from fifty stalks with two ears without any selection as to the best. The result was 3 pecks. The bushel weighed 56 pounds, and the three pecks 42 pounds. The experiment was in favor of stalks which bore two ears.

THE MOWING OF HAY

On the station is a demonstration that ought to change any farmer from the pulling of fodder to hay-making. Annually there is more money wasted by neglecting hay than is made on the cultivated products of the field. It is not to be thought, however, that every farm will produce hay, unless care is taken to protect it from destruction. Cotton requires such close and late cultivation as to destroy it, to a very large extent. The system of cultivating corn so largely practiced in Florida, that is, in working it every twenty-one days, thus making the last plowing in June, has the same effect, and is beyond doubt injurious to hay, the last cultivation killing the grass. Pasturing stock in fields in the fall is also damaging to it. Doubtless every farm in the State, from the smallest to the greatest, has meadow or special spots from which enough hay can be mowed to run it, but then, by care the corn fields can be used for this purpose.

There are parts of the station that two years ago were utterly useless for hay. The small red stem, or "poor man's" weed, covered the ground, with here and there a bunch of crab and crow-foot grass. These were allowed to seed, the land being cultivated last year in melons and the year before in millet, which were off early. From indications, next year there will be a fine crop of hay to harvest. This plot is on the brow of a sandy hill, which has a fall of at least seventy-five feet to the lake in a quarter of a mile.

Hay-making would be largely assisted by taking out the stumps. And stump-digging and burning in the fall, if it were followed as a part of the business of the farm, would soon clear every one of stumps in the State. Avoid using a STUMP PULLER, for it is cumbersome, tedious and utterly useless in pine or sandy hammock lands.

It is necessary, in order to use a mower, that the stumps be taken out, unless every stump is flagged and this is too expensive. But hay can be cut with a grass blade where the stumps are too thick for the mower. Two years ago when the station was full of stumps 12,500 pounds of hay was mowed with grass blades from eight acres. This hay was cut by inexperienced hands and an acre of grass was mowed and raked by hand as easily as one of fodder was pulled and gathered. But mowing with a two-horse mower in a stumpless field is charming work. On smooth land from eight to twelve acres can be mowed a day, according to the speed of team and experience of the driver. On uneven land less.

The planting of corn and mowing the hay after the corn is ripe and gathered without cutting down the stalks was successfully demonstrated this year.

The first effort was made by cutting down the stalks under the ground with hoe and piling them and then using the mower. This was found to be tedious and expensive. A trial was made to make the mower cut the stalks down and mow at the same time, gathering the stalks in heaps afterwards. This was found to be practicable and the question of mowing hay in a corn field solved.

The plan followed and found the best was to mow in narrow strips across the beds. In a field from an acre to ten wide a strip across the field from one-fourth to one acre wide, would give room for easy turning. The longer the strips the less time is lost in turning.

This year there was more dirt thrown to corn than was intended and the beds were quite high. The mower went over them very easily, clogging occasionally but doing its work well and expeditiously. From five to eight acres can be cut a day. One draw back to this is that the work is hard on the knife. When it strikes the joint of a large stalk it sometimes fails to cut it. The mower must then be stopped and relieved. These hard stalks also gap the knife, but not to such an extent as to render it useless One knife mowed the Station field this year and it is ready for work another season. Every mower should have at least one extra knife, if not two for every season's work, although a knife may last many seasons.

In connection with the mower must be a horse rake. This rakes the hay very rapidly in piles ready for hauling from the field.

The damage sustained by hay being rained on is not as great as is supposed, judging from the eagerness with which stock consume it even after it has taken showers for three days, not continuously but often enough to prevent its being housed. The color suffers for it is not so bright and it is possible the value may be affected, which, I think, is overestimated, but to what extent, if any, is not fully determined, but will be in due time.

The native grasses which make our best hay are crab, crow foot, sand spur grass and beggar weed.

Cow peas sowed in rows and on poor soil but fertilized will make fine hay. They are cured on the Station by mowing one day and allowed to remain until after the dew is off them the next. They are then stored in barn where they can have air several days before being packed away. By this simple and cheap method the leaves mostly adhere to the vine.

THE YIELD OF HAY.

On 13⅜ acres was cut 19 tons of crab grass. On 2 1-5 acres 1½ tons beggar weed. The weed was not thick. On 1¾ acres 2 tons cow peas. The peas were sowed in July in rows three feet apart and fertilized with equal parts of kainit, cotton-seed meal and acid phosphate, at the rate of 500 pounds per acre. The same plot last summer sowed about the same time and unfertilized did not make the seed planted. Had the season been propitious doubtless the yield this year would have been much larger. The pea planted was the little yellow Crowder, which is not the best for hay.

From one acre of high-land planted in corn made 1,500 pounds of crab grass hay.

The unusual drought of August, September and October, with a severe frost in the early part of the latter month, cut off the second crop on corn land.

By comparing yield of hay with fodder the farmer can readily see that fodder-pulling is time and money lost. Again the hay is as valuable as the corn crop; on upland and on bottoms is worth half as much more.

THE WEEVIL.

I am not prepared to state that I have solved the weevil pest. The matter still remains in doubt, but my experience the past two years is such that I deem it a duty to give it to the public and ask the co-operation of farmers with me on this line.

When I took charge of the Station, nearly three years ago, there were several hundred bushels of corn in the crib badly affected with the weevil. This was the 1st of February, 1889. Upon inquiry I found the corn had been made after the usual custom of the country. That is it was worked with sweeps, four furrows to the row, and worked three times at intervals of twenty-one days, having, however, for its first working a furrow around the corn, the dirt being thrown off and then thrown back. This system of cultivating usually leaves the last plowing to the time when the corn is in the tassel. In laying by, to avoid the injury sustained by plowing out the corn row by row, if the season is dry, some farmers plow out every other row, and in a week or so afterwards plow out the other. In 1889 I planted corn and gave it the same number of workings usually given, observing the same intervals, using instead of sweeps cultivators. I noticed the last plowing caused my corn to fire, although the seasons were good and the crop highly fertilized. All the fodder was taken from the stalk at the usual time, about the 1st of July, as had been done the previous year. The corn was housed in the same crib, and like the previous year, badly eaten with weevil.

Last year, 1890, I determined to change the system of cultivation. I therefore, after breaking up the field in January let it alone until the 14th of March, when I opened furrow, fertilized and covered it. The 24th I opened furrow and planted. When the plant was about two inches high I ran a sharp-tooth harrow across rows and began to work it with cultivator April 11th, working it also the 25th, and May 13th when I laid it by. The fodder was not pulled. A part of this crop was gathered by cutting corn and stalk together, stacking it in the field and then storing it in a house several hundred yards from the barn in which corn had never been housed. The remainder of the crop was gathered about the middle of August and stored in the same crib where it had suffered from weevil before. Last year in the hill country of this county, Columbia, corn was early and very badly injured by the weevil. The Station corn, except a few ears that had fallen on the ground, was almost entirely free from the pest. The corn which I had laid by for seed was uninjured. The lot, however, which was cut, stacked in the field and housed to itself was almost literally consumed by the weevil. After repeated personal examinations of the corn established its soundness, I resolved to pursue the same system of cultivation this year and watch results. This was done, with the exception that there was an interval of seventeen days instead of twelve between the second and last plowing. The result is that all my corn is free from weevil, except that raised on new bottom land. This plot, while worked like the rest did not suffer from drought like the hill corn, but grew steadily and matured earlier. It was not as perfect as the hill corn, inasmuch as the the cob grew longer than the shuck in some of it, and the shuck did not cover the cob of the remainder as perfectly. Doubtless the lateness of the last plowing had some effect in producing these results. In my opinion this condition let in the weevil, which lays its eggs in the corn when it is in the milk, or as long as the grain is soft enough for it to be pierced by the female in order to deposit its eggs. That the weevil finds its way into corn at this period is an undisputed fact. That it propagates itself afterwards and attacks hard corn is not conceded.

The time then to protect corn must be when it is in the field. But how is this to be done?

I observed last year and this that the corn unaffected with weevil was perfect in its development. That is the cob was uniformly filled out to the end, whether small or large, with well matured grains and that the shuck covered the entire ear, adhering closely to it and extending beyond firmly, closing around the end and thus protecting it. I noticed further that the pulling of fodder had the effect of causing the shuck to loosen on the ear and as this is usually done before the grain was too hard for the weevil to pierce it for egg deposit, it suggested to me that fodder pulling was possibly a fruitful cause in assisting the weevil into getting into corn.

For the pulling of fodder exposes the ear to the sun and causes the shuck to loosen on it, thus making it easier for the weevil to find its way to the grain. Again fodder pulling, done at the time it usually is, before the stock and ear are matured does result in preventing the shuck from adhering naturally to the ear and thus nature's protection of the grain from its enemies is seriously interfered with. That the shuck serves as such a protection and is for that purpose, scarcely anyany one will doubt. If this be true, therefore, it becomes a matter of the first importance to cultivate corn upon such methods as will produce the best results. And if corn is cultivated so as to produce the heaviest grain and its natural and most perfect development, then it is reasonable to suppose that this condition will protect it more thoroughly against its enemies, if not entirely.

Whether there is anything in this theory remains to be seen. I am sure of this, however, that the working of corn as late as the common custom is must be an injury. For when the corn "bunches to tassel" is the time when nature makes every effort to reproduce itself. It is then that the tops grow slowly or slower than they did until this stage of development is reached, and the roots begin to spread in every direction, in order to meet that period when the plant suddenly shoots into tassel and begins to ear. To mutilate the roots at this time must result in small, imperfect ears, commonly called "nubbins," with more cob than grain, and grain improperly developed, and cob unfilled with grain and covered with shuck. Uniformity and normal or natural growth of cob, grain and shuck must be the object of the farmer in order to obtain the best results. It would, appear, therefore, that if working corn and mutilating the roots, at a period when such results follow, even if the corn is in the grass, should be discontinued. And if working corn so late produces a condition favoring the weevil it farther appears that the custom ought to be abandoned. These are the only facts I adduce and here suggest them in the hope that the thoughtful farmer may duly weigh them and with me coöperate in testing them.

It may be observed that the corn brought here from the West in sacks, in the month of January and stored in the same crib where the weevil had eaten the corn badly, is not attacked by the weevil. Corn has been kept in my private crib for months and was not injured, and for two years on the Station I have kept it for two months at a time and have never known it attacked and eaten. Weevil may crawl in and through it to some extent, but they do not injure it like the corn which is grown and cultivated on the systems which are common to our State.

ENSILAGE.

Experiments in ensilage began in 1889. Without any experience with ensilage and silos and with only that information obtained from reading various reports concerning them, which were conflicting, a silo was planned and built of wood on top of the ground and upon the slope of a hill.

No sills were used, the studding being sunk into the ground like posts. Two walls were made, one on the inside and the other outside of studding, and to make it air-tight the spaces between were filled and packed with dry sand. This is cheaper than tarred paper and as good. The silo was covered and a window cut in the gable end. Trenches were dug under the eves to turn off water during a rain. The floor of silo was leveled and the dirt packed firmly.

The silo was filled with corn, cow-peas, beggar weed and crab grass, uncut, in the order named. The corn was laid in regularly and packed, and so were the other materials. The whole was covered a foot deep with Spanish moss, on which was a layer of plank, weighted with barrels of sand. The ensilage rotted. Where moss is abundant and easily gathered it is a good covering for silage. Besides the heat of the silo prepares it for practical use.

Last year another was built above ground, half the size of the other, but with tarred paper between the walls.

Both were filled with uncut corn, laying it carefully and packing it firmly. The experiment was a failure. The corn did not rot, but it was too large to pack closely and hence dried out. Having failed two years without cutting corn to make ensilage, a cutter was tried and this year both corn and sorghum were cut, and siloed and cured successfully. Not having material to fill both silos the one first built was used. The following statement will give some idea of the cost of making ensilage on the Station :

The cost of silo was	$ 45	00
The cost of cutter, carrier and two horse power	125	00

Three and one-half acres of corn planted one foot apart in row make twenty tons ensilage or five five-seventh tons per acre.

The fertilizer to make this corn cost	$ 37	50
Seed	1	75
To prepare land, fertilize it and cultivate it	13	00
Hire of six hands and five mules five days, to cut down corn, haul it and cut it up	48	00
The corn on ensilage patch averaged 35 bushels to acre, at 60 cents	73	50
	$173	75
In addition to this add one-third cost of silo, for a silo built of wood in this climate will not last longer than three seasons	15	00
	$188	75
Twenty tons ensilage, cost per ton	$ 9	43¾

I do not consider this year's experience a fair test, because the larger part of the corn was planted too far from the silo, nearly a quarter of a mile, and hence it required more time in hauling than if the field had been nearer. Besides this the land was the poorest on the Station and the crop was injured by the dry weather, which made it lighter than it would have been under more favorable seasons. But while this is true it is a question whether the silo is destined to be a success in East and South Florida unless very rich land, heavily fertilized, can be had on which to grow the corn and produce a much larger yield per acre than ordinary soil will under favorable seasons. In Middle Florida several stock raisers speak of it in the highest terms and consider it indispensable. One of these does not cut his corn in siloing it and the year I visited his silo it was a success, but his corn was small and spindling, the stalks having but little, if any, corn on them. But the cost of putting up the corn without cutting it and afterwards preparing it for stock by cutting in proper lengths with ensilage knife, or broadaxe is costlier than if cut up before packing it away.

The only advantages which ensilage possesses in our climate appears to be—

1st. That forage can be put up during our rainy season with but little loss. About twenty per cent was our loss this year.

2d. A large amount can be stored in a small space.

Cows, horses and hogs eat it with relish, but after feeding forty-five pounds with a ration of two quarts of corn meal per day to cows for three weeks the milk and butter production measurably decreased.

The silo will not be an advantage to the farmer unless he has from eight to twenty cows or more to feed, and even then it is doubtful. A silo can be built about six or eight feet square and from sixteen to twenty feet high and be fed fast enough to eight or ten head of cattle to prevent it from spoiling. For unless the exposed surface is fed, about three inches a day, in our climate, the ensilage will sour and mould and hence deteriorate in value as it will also in palativeness.

A silo built sixteen feet square and twenty feet high, for the higher it is the greater the pressure, and hence the denser the ensilage and the better its keeping properties, and divided into four compartments will feed ten head of cattle by using one of the departments at a time, possibly without spoiling, 520 days or twenty head 256 days. A silo could be built 8x16 feet by 20 feet high and divided in two parts and will feed ten head of cattle 256 days, but one smaller than this would hardly be of any practical advantage.

A silo built twenty feet high and divided into two or four parts would cost from one-half to twice as much as one having only a single chamber, while the cost of filling two or more chambers would be increased. This increase of cost would be occasioned by moving the power and cutter, so that the carrier could be adjusted to the different chambers.

It does appear that unless a farmer combines a dairy with his farming or fattens beef for the market that a silo in this State, where winter pastures of rye can be grown cheaper than ensilage can be made, is of no advantage.

Moreover the relative value of ensilage and hay as a butter and milk and fat-making feed is not determined as yet. In States where cattle raising and dairying are leading industries, the question as to whether ensilage is a profitable cattle feed comparatively is being thoroughly tested by every method known to science and thus far the opinions vary.

The Station silos were not built upon proper models, for the amount of stock we have, as experience demonstrates since in feeding, there was too large and long an exposure of the surface to air to keep the ensilage from spoiling. Various experiments will be made the coming year.

In building a silo the following points should be considered:

1st. That corn makes the best ensilage. That its value depends largely upon its earing. That if planted less than a foot apart in drill it will not ear well, but will be small and spindling. In this condition it can be siloed without cutting, if laid evenly in silo and packed so as to exclude the air; but cutting it in three-quarter inch lengths before putting it up is the cheapest, best and surest way of preserving it.

2d. The number of cattle to be fed.

3d. That a cow eats from 33 to 40 pounds per day.

4th. That the best way to take ensilage from a silo is from the top, unless packed uncut, when it must be cut to be taken out for feed at the end. These methods retain the heat of the silo more evenly and protects against loss.

5th. That from two to three inches of the top or from the end should be taken off daily to prevent souring and moulding.

6th. A silo eight feet square and twenty feet deep holds about twenty tons of ensilage. It would require two or three inches a day taken from the top to keep it from spoiling and that amount would feed ten cows.

7th. Wood is the best material to build with, rock or brick costing in our State more than double as much.

8th. No advantage is gained by building below the ground, except in filling the silo. This is more than counter balanced by the labor of getting the silage out.

9th. The loss from rotting in silo is estimated at 20 per cent. This percentage varies according to the size of silo. A small silo has a larger percentage of loss than a large one.

RICE.

Four experiments were made this year in rice. The seed were sowed April 1st. The stand was a poor one in consequence of dry weather which replanting did not help much.

Plot 1 was on old land, sandy but level. And was fertilized with equal parts of phosphate and cotton-seed meal at the rate of 1,000 pounds per acre. The yield was 10 bushels per acre.

Plot 2, unfertilized, old land, the same as plot 1, with stand as good, yielded 7½ bushels.

Plot 3 high hammock, new and unfertilized and planted one year in sweet potatoes. The yield was 21½ bushels.

Plot 4 was bottom or meadow land, unfertilized, and planted last year in sweet potatoes. Yield 55 bushels per acre.

The first working was done April 20th with bull-tongue, two furrows to the row. It was also plowed May 14th and 29th, and June 22d with a 14-inch sweep.

The rows were 2 feet 6 inches apart and the rice dropped 18 inches in row.

The plots were hoed and replanted May 6th; hoed again May 30th, and again June 26th. A partial hoeing was given it where stand was missing.

The results clearly indicate in connection with the two previous years experiments that old sandy land, even heavily fertilized, is not profitable on which to grow rice.

The high and fresh hammock, it is fair to state, would have made a finer yield had the season been more propitious. The bottom land yielded well and if a good stand had been obtained, it is safe to say, one-sixth better results would have been developed.

With the establishment of rice mills in Florida and the prices paid for rough rice, viz: 80 cents per bushel, I would call attention of farmers to a more general cultivation of this crop, where they have one or more acres adapted to its growth.

The crop can be readily harvested with a mower, provided one row is cut at a time. To use the old hand reaper is too tedious and expensive. The scythe, next to the mower, is the best tool for reaping, but where the rice is thick and large it is heavy work. The flat pine woods land of Florida would doubtless make paying crops. The common custom of hanging the rice on a pole in the field for a week or more before housing it, not only wasts the grain, by hauling it after it is dry, but injures the straw, which is a superior forage for horses and cows when properly handled. While rice is easily heated if packed away too green, and the straw damaged by mould, still if placed under shelter after it has had the sun a few hours, it will cure rapidly, without damage, provided it is put loosely in heap and turned over several times to give it air. The Station crop was so treated this year and the saving in grain and time, with the quality of the forage taken into consideration, warrants me in making this suggestion to those who plant small crops.

SUGAR CANE.

This crop, on old and high land on the Station, heavily fertilized, is a failure. For three seasons there has not been the least encouragement in its cultivation. The past year, however, it was also tried on fresh hammock, both high and low, which was the year before planted in sweet potatoes. The yield in good syrup on high hammock was 227½ gallons, and on the low, 460 gallons per acre.

The plot was prepared by breaking up land with one-horse plow, and laid off in five-feet rows. The cane was dropped single in the rows four inches apart. Two tons of black cotton seed per acre was then distributed on top of cane and covered with two furrows. The stand was good on low hammock, and poor on the high. In June 800 pounds per acre of cotton seed meal and acid phosphate, equal parts, was broadcast between rows, and worked in with cultivator and the crop laid by.

The cotton seed were not killed when put in cane rows, and considerable loss was sustained by their sprouting and coming up. Two hoeings and three plowings made the crop. The advantage of the last fertilizing was very marked in developing the crop. Had the season been more propitious there would doubtless have been less disparity between the yields of the low and highland crop, and each would have been larger. Cane must have moisture and a rich soil. High, thin lands, whether fresh or old, however rich they may be made, does not appear to be adapted to cane, nor can it be grown on such soil profitably, even for family use. The flat pine lands of the State, if properly fertilized, will doubtless make paying crops, and arrangements are made for future experiments on such land.

The crop was worked up this year with horse mill and evaporator, and hence the percentage of yield is not as large as when more improved machinery is used.

On one-twentieth of an acre of low land there were 1,005 cane, which weighed 1,386 pounds, which made 186 gallons of juice, each gallon weighing 10 pounds. This made 23 gallons of syrup, weiging 12 pounds per gallon, or one gallon of syrup to a little over 8 gallons of juice. On high hammock on one-tenth of an acre 963 cane were cut, weighing 1,354 pounds. The juice and syrup weighed the same as the bottom land. The yield of juice was 172 gallons, which made 22¾ gallons, or one gallon of syrup to a small fraction over 7 of juice.

TEXAS BLUE GRASS.

The conduct of this grass for the past three seasons has been very encouraging. Its history on the station deserves the serious consideration of every farmer in the State who desires a fall, winter and spring pasture. I found on the station in January of 1889 a small plot of this grass growing in rows about twenty inches apart. It was planted on the top of a high hill, which turned out to be the best land on the Station, being good, firm, moist black soil. Up to February it had been weeded and protected from grass. It grew luxuriantly and to the height of fifteen inches, and seeded in April. From that time until now it has never been worked. It was allowed to compete with native grasses, broom sedge, fennel and briars, for the supremacy, without any assistance whatever, not even the cutting away of the grasses, weeds and briars in the fall, to give it a better chance. The result is, that while it has not seeded since 1889, it has taken possession of the plot, and is now, December 26, 1891, over twelve inches high. It has formed a thick sward, and is a luxurious pasture of beautiful green grass, in spite of dry weather. For the three past seasons by the first of November it has been ready for pasture.

Last December I planted another plot with seed on a sandy hillside. The land was thoroughly broken up and fertilized by broadcasting at the rate of one-half ton per acre of cotton seed meal, acid phosphate and kanit. The seed were six weeks coming up, and the grass grew slowly and did not seed. The seed, drilled very thickly in six-inch drills, germinated freely, but the plants only reached a height of about six inches through the season, remaining green, however, until the first of June. This fall this plot did not put out as early as the first one, but since the 1st of December it has furnished an excellent pasture, which has been grazed daily for two weeks. Cattle, horses and chickens are fond of it. Its color is deep green, and, if allowed to grow to the height of six inches, after it had taken possession of the soil, it would make a beautiful lawn.

The best method to obtain a pasture of this grass is in favor of planting the seed. While roots will grow and spread, still this is slow and tiresome work, to say nothing of the cost and the danger of losing plants from dry weather Twelve pounds of seed will sow an acre of ground, and, while they will cost $2 per pound, still it is worth the expenditure in view of the profits. Once started, the pasture is a fixture. If sowed in low ground, rich, moist but well drained, it will furnish an enduring pasture. It does not appear to be a troublesome grass to get rid of, if such were desirable, for, if plowed up in the spring, my opinion is it would be easily destroyed. On rich soil the plant will seed annually, and thus furnish the means to enlarge the area.

In late summer the first plot was divided into three parts. The first was fertilized and broken up. The second was fertilized and not broken up. The third was unfertilized and not plowed. There has been no appreciable benefit thus far, December 26, from either breaking up or fertilizing. This, doubtless, is the result of dry weather. That which was broken up was injured. If, however, the cut-away harrow had been used to break up the heavy turf, the likelihood is the result would have been good.

On good, firm high lands a pasture of this grass can be grown with profit. On meadow or low lands it will grow luxuriantly and rapidly, furnishing a rich pasture when our summer grasses begin to fail in the fall. To secure a good stand and to aid the grass to obtain the mastery of the soil it will be necessary to keep down the weeds and native grasses for at least the first year.

LONG OR BLACK SEED COTTON.

This experiment was conducted with different fertilizers to test the best and cheapest for old land which was high and dry, and to demonstrate whether it would pay to fertilize and cultivate such soil in cotton.

The season was very unfavorable by reason of droughts in the spring and early summer and a very small rainfall in July and August.

The stand was good and by replanting was made perfect. About tbe middle of July it was badly attacked by rust, which caused the loss of its top crop. It fruited well but the effect of dry weather on the development of bolls was very marked, they being small and the lint of poor quality.

The experiment clearly demonstrated that in a dry year it does not pay to fertilize long cotton. For in exceptionally dry years fertilizers are not as available to growing crops as when there are good seasons to prepare them for plant use.

A noticeable effect of cultivation, however, must be observed on the unfertilized plot, as to yield compared with the fertilized. This land was known to be very poor and it was not thought that its yield would be, at best, over 150 pounds of seed cotton to the acre. Doubtless the yield of 253 pounds is due largely to the *cultivation*.

The plots were laid off in four-feet rows. This was done by running furrows every four feet and distributing the fertilizer in them and then bedding on them; breaking out the middles fully. The unfertilized rows were bedded, the same way. On March 2nd the rows were fertilized and bedded and on March 30th they were opened and planted.

The system of running round and near the cotton and thinning to a stand was discarded. The thinning was done by hoe and hand. When the plants were too close together to use the hoe, the cotton was pulled out and a little dirt drawn to it. This avoided wounding the plant and assisted in securing a good stand.

It is was worked with cultivator twice, and the third time with a 22-inch sweep. Care was taken the last time to plow shallow, to throw as little dirt to the plant as possible and not to run nearer than six inches to it. By this practice the roots are not cut or disturbed and there was no shedding. Cotton cultivated this way has never shed its blooms or fruit for me, whether the season is dry or wet. The plots received one full hoeing and two partial hoeings. The last two consisted in going over the plots and cutting out grassy patches.

Plot 1 was fertilized with Station compost No. 1 and yielded 478 pounds per acre.

Plot 2, fertilized with Station compost No. 2, yielded 504 pounds.

Here we notice the results of iron again.

Plot 3, unfertilized, yielded 253 pounds per acre.

Plot 4 had 1,000 pounds of Kainit per acre and yielded 260 pounds.

Plot 5, 1,000 pounds Acid Phosphate, yielded 261 pounds.

Plot 6, 900 pounds Acid Phosphate and Kainit, equal parts, 360 pounds.

Plot 7, 900 pounds Acid Phosphate, Kainit and cotton-seed meal, equal parts, 398 pounds.

Plot 8 had 1½ tons of cotton-seed and yielded 300 pounds. Plot 2, fertilized with compost No. 2, in which was iron, makes the best yield. From experiments in corn and cotton the indications are that the application of iron on our sandy lands is a benefit.

JAS. P. DEPASS,
Director.

BULLETIN No. 17

— OF THE —

EXPERIMENT STATION

OF FLORIDA,

— AT THE —

State Agricultural College,

LAKE CITY, FLA.

I. ANALYSES OF THE ORANGE.
II. HORN FLY.
III. QUESTIONS CONCERNING STOCK DISEASES.

REV. JAS. P. DePASS, Director.

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ANALYSES OF THE ORANGE.

(*PRELIMINARY REPORT.*)

BY J. M. PICKEL AND J. J. EARLE.

A year ago last January we began a series of analyses of the orange. It was intended that all the leading varieties should be embraced. The following points were to receive attention: Chemical composition of the orange as a whole, with reference particularly to quantity of fertilizers extracted from the soil; composition of separate parts (peel, seed, pulp and juice); percentage of peel, seed, pulp and juice; percentage of sugar and acid in juice; average weight, specific gravity and keeping quality of each variety. It was, and still is, intended that this work shall extend over several seasons; but as yet only one season has been given to it, and not all the points mentioned above were covered. We have concluded, however, to publish such details of the work as will be of use and interest to growers. Future analyses, covering oranges grown in different seasons and over a greater extent of territory, variety of soil, etc., will doubtless modify, to some extent, the figures given in this article.

The varieties and localities represented are Dancy's Tangierines, Mandarins, Majorica, Jaffa, Parson's Navel, Maltese Bloods, Imperial Malta, Double Imperial, sent on and presented by Rev. Lyman Phelps, Sanford; True Indian River and Foundling Indian River, sent on and presented by ex-State Senator Williams, of Rockledge; the common sweet, bitter-sweet and sour orange grown in Lake City. The gentlemen mentioned have our thanks for their kind co-operation.

EXHAUSTION OF THE SOIL BY THE ORANGE.

The following is the average approximate composition of the orange. This average is made up from all the varieties mentioned above:

		(a)		(b)
Moisture	per cent.	87.710		....
Organic Matter (exclusive of nitrogen)	"	11.246		....
Nitrogen	"	.124		....
Silica	"	.009	0.916	1.00
Sulphuric acid	"	.042		4.86
Phosphoric acid	"	.077		8.63
Ferric oxide	"	.006		0.68
Lime	"	.207		22.77
Magnesia	"	.045		5.01
Potash	"	.479		52.05
Soda	"	.039		4.26
Chlorine	"	.011		1.23
		99.996		100.49
Less oxygen for chlorine				.28
				100.21

Column (a) gives the percentage of the constituents in the fresh orange as a whole, (b) those in the pure, dry ash.

Different oranges of the same species differ often very considerably in composition. For example, the ash of the Navel, as grown and analyzed in California, shows 47.5 to 55.3 per cent. potash, 16.4 to 26.4 per cent. lime, 9.8 to 14.2 per cent. phosphoric acid, 4.2 to 7.9 per cent. sulphuric acid. This difference is due to a great extent, no doubt, to difference in soil, fertilization, climate, etc. But it is a question if oranges from different parts of the same tree might not differ in composition. It is also a question whether or not different species, if grown under uniform conditions of soil, fertilization, climate, etc., would exhibit characteristic differences in the proportions of ash constituents. Our analyses of the ashes give sulphuric acid 3.3 to 6.8 per cent.; average, 4.86 per cent.; phosphoric acid, 7.5 to 9.8 per cent.; average, 8.6 per cent.; lime, 13 to 32 per cent.; average, 22.77 per cent.; potash, 42 to 59 per cent.; average, 52 per cent.; magnesia, 3.5 to 6.4 per cent.; average, 5 per cent.; soda, 2.8 to 5.5 per cent.; average, 4.26 per cent.

What proportions of the various constituents should an orange fertilizer contain?

Taking our average analyses as a basis, a fertilizer which is to restore to the soil the plant food removed by the orange should be composed as follows:

		Fla.	*Cal.*
PHOSPHORIC ACID,	parts by weight	1.0	1.0
NITROGEN	" "	1.6	3.4
POTASH	" "	6.0	4.0
Lime	" "	2.7	....
Magnesia	" "	0.6	....
Sulphuric acid	" "	0.5	...
Soda	" "	0.5	....
Chlorine	" "	0.14	....
Silica	" "	0.10	....
Ferric oxide	" "	.08	....

It is commonly accepted as true that the planter need concern himself about only the four first, all the others being, with rare exceptions, abundantly present in all soils. The rare exceptions are, perhaps, sulphuric acid and magnesia. The latter (as also lime) is always abundantly present in acid phosphate, or can be supplied in the form of gypsum or land plaster. Magnesia is rarely absent from any fertilizer, amounting sometimes to 10 per cent. or more. Silica never needs to be supplied; nor do ferric oxide, soda or chlorine; or, if they do, they are always present as incidental parts of all fertilizers, often to so great an extent as to be a nuisance. The orange draws *potash* from the soil in far larger quantity than any other constituent. This is, however, precisely that constituent which is relatively deficient in popular orange fertilizers now on sale in Florida. These fertilizers contain from 1 to 2.5 times as much phosphoric acid as potash, and 2 to 5 times as much phosphoric acid as nitrogen. Whereas, according to our analyses, the orange takes from the soil 6 times as much potash and 1.6 times as much nitrogen as phosphoric acid (in case of the California orange, 4 times as much potash and 3 times as much nitrogen). That one of these three most important constituents of which the orange removes the least, the one, moreover, which is most likely to be present, and often actually is present in Florida soil in excessive abundance, namely, phosphate, is the one which these fertilizers supply in excess. A fertilizer which would return to the soil the constituents extracted by the orange, should contain about 2.7 per cent. phosphoric acid, 4 per cent. nitrogen, and 16 per cent. of potash. These remarks have reference to old bearing trees. Our analyses are of the orange merely, not of the leaves, trunk, root or twigs. The leaves and new growth extract food from the soil, but this should, by decay of leaves and burning of prunings, be returned. (In case of burning the nitrogen would be lost.)

Should the compounding of a fertilizer be controlled by the composition of the crop for which it is intended? In other words, should the relative quantity of each constituent that is to go into a fertilizer be determined by the quantity that the crop extracts from the soil? It is undoubtedly safest to do this in all cases where the natural capacity of the soil is unknown; also in all cases where the soil is known to be deficient in all elements of plant food. In cases where it is known that one or more constituents of plant food is already abundantly present and available in the soil, or only partially deficient, that constituent should either not be supplied at all or only in such quantity as to supplement the partial deficiency. In a word, the farmer should understand thoroughly his soil, its deficiencies and its excellences. In accordance with this knowledge and a knowledge of the crop to be grown, he should compound his own fertilizer, or else have the manufacturer compound it for him in accordance with formulas suited to his own peculiar needs.

QUANTITY OF FERTILIZER CONSTITUENTS REMOVED FROM THE SOIL BY 1,000 FRESH ORANGES (APPROXIMATE).

		General average of all oranges analyzed.	Mandarines and Tangierines.	Jaffa, Navel, Maltese Blood, Imperial Malta. Double Imperial.	Indian River and Foundling Indian River.
Weight of 1,000 oranges in ounces		6,881	4,985	7.112	7,870
NITROGEN,	"	8.4	7.0	6.4	7.4
Silica.	"	0.7	0.4	0.7	0.7
Sulphuric acid,	"	2.9	2.0	3.6	2.2
PHOSPHORIC ACID,	"	5.4	2.5	6.4	5.9
Ferric oxide,	"	0.4	0.3	0.5	0.2
Lime,	"	14.6	4.0	16.4	21.4
Magnesia.	"	3.2	1.5	3.6	3.7
POTASH,	"	34.1	16.5	42.7	29.5
Soda.	"	2.3	1.5	2.8	2.2
Chlorine,	"	0.8	0.5	0.7	0.7
Total		72.8	36.2	88.8	78.9

For quantities removed by each variety see table of analyses. A thousand fresh California oranges (general average), remove 33.8 ounces potash, 8.5 ounces phosphoric acid, 29 ounces nitrogen. The difference in nitrogen between the California and Florida fruit is remarkable, and in phosphoric acid not inconsiderable.

The quantity of an excellent and popular fertilizer recommended to be applied on old bearing trees on pine land is such as would furnish yearly to each tree 22 to 39 ounces of available, to say nothing of the insoluble, phosphoric acid; 23 to 39 ounces of potash, and 10.5 to 18 ounces of nitrogen. The phosphoric acid is greatly in excess of what would seem to be needed, and the nitrogen somewhat so.

The fertilization of fruit trees is a subject about which there is little accurate knowledge, and greatly needs to be studied. The formulas for orange fertilizers undoubtedly need to be revised; the quantity of potash relatively to the other constituents needs to be increased. A fertilizer containing something like 2.7 per cent. phosphoric acid, 4 per cent. nitrogen and 16 per cent. potash, would restore these elements to the soil in something like the relative proportions in which the orange takes them. About 12.5 pounds of this fertilizer would be enough for the production of 1,000 oranges. The orange is a large consumer of lime, and makes no inconsiderable drafts upon sulphuric acid. Those constituents should be looked after. And there doubtless are soils which would respond gratefully to an occasional application of magnesia.

WEIGHT.

The following table shows the average weight of a single orange of each variety. The number in parentheses after the name of the variety indicates how many oranges were weighed. This number in each case is small, and the average based upon it cannot be more than approximately representative. The weighings were made in three to nine days after the oranges left the tree. The process of seasoning or drying out begins as soon as the orange leaves the tree, and, of course, the weight decreases constantly. Further on we give a series of weighings showing this. The rate of decrease depends, among other things, on the dryness of the atmosphere, temperature, kind of exposure, etc. The texture of the rind has also doubtless something to do with it. It seems not improbable that the keeping power of an orange is influenced by the rate at which the drying-out takes place.

VARIETY.	Number of days from tree when the weighing was made.	Average weight of a single orange in ounces.	Average weight of 1,000 oranges in pounds.
Majorica (12)	6	7.46	466
Jaffa (6)	9	7.57	473
Parson's Navels (10)	8	7.75	484
Maltese Blood (22)	10	6.68	418
Imperial Malta (22)	11	6.82	426
Double Imperial (14)	13	6.74	421
Indian River (24)	4	7.69	481
Foundling, Indian River (24)	6	7.61	441
Dancy's Tangerines (12)	8	4.60	288
Mandarins (15)	8	5.37	336
Sprack (2)		6 18	386
Select (6)		2.62	164
Columbia County (22)		7.58	474
Bittersweet (22)		6 93	433
Sour (24)		7.80	488

SPECIFIC GRAVITY.

It hardly need be explained that by the specific gravity of a solid or liquid substance, is meant how many times heavier or lighter a given volume of that substance is than an equal volume of water. If the specific gravity of an orange is greater than unity (that is if the "orange," to use a popular expression, "is heavier than water"), it will sink in water; if less than unity, it will rise and float; if equal to unity, it will neither sink nor rise. The water here spoken of is pure (distilled or rain water); and in very accurate work the temperature must be considered.

In the following table is a record of the weight and specific gravity of ten oranges from week to week. It shows the interesting fact in that, whereas the weight of an orange constantly decrease, the specific gravity increase for a while, then afterwards falls off. This means that for a period after plucking, the orange becomes more and more compact, then afterwards "loosens up," so to speak. When the first weighings were made, the oranges had been plucked from the trees three to nine days. The determinations of specific gravity were made at intervals of about a week, until decay of the orange was observed to have set in. In all cases except one, the initial specific gravity was less than unity. This case is not to be reckoned as an exception, for the reason that the orange was three weeks from the tree at the time the determination was made. In eight cases the specific gravity gradually increased during the first three to six weeks, then declined. In two cases there was a decline from the first. In six cases the increase reached a maximum of over one. In all cases there was a constantly increasing loss of weight. If these ten oranges fairly represent what usually takes place, the matter may be summed up as follows: (1) The specific gravity of a freshly pulled orange is generally less than unity, that is, it will generally rise to the surface if placed in rain or distilled water; (2) The specific gravity of a fresh orange generally increases for a while as the drying-out goes on, then decreases, the maximum often exceeding unity, that is, an orange which at first would rise in water will after a few days or week sink, then later rise.

In making up the scale for honors and medals, weight is put down at 10. In view of our record, it would be manifestly unfair to compare the weights of oranges that had been pulled from the trees different lengths of time.

WEIGHT AND SPECIFIC GRAVITY AS EFFECTED BY LENGTH OF TIME FROM TREE.

Variety.	Days from Tree.	Weight.	Loss of Weight.	Per Cent. of Loss.	Specific Gravity.
Majorica	7	205	....	....	......
	14	292	13	6	
	21	180	25	12	.9995
	28	168	37	18	1 0083
	35	159	46	22	1 0122
	42	152	53	26	.9805
	49	145	60	29	.9592
	56	140	65	32	.9332
	63	132	73	36	9005
Jaffa	7	210	....	....	.
	14	199	11	5	
	21	188	22	10	.9725
	28	174	36	17	.9857
	35	162	48	23	1.0029
	42	154	56	27	9999
	49	147	63	30	.9802
	56	142	68	32	9583
	63	133	77	37	.9226
Navels	3	243			.9641
	14	224	19	8	.9651
	21	211	32	13	9952
	28	200	43	17	1 0076
	35	191	52	21	1 0178
	42	185	58	24	1.0128
	49	181	62	25	1 0015
Tangerine	3	129	....	..	.8703
	14	121	8	6	8344
	21	115	14	11	.7982
	28	109	20	15	.7597
	35	104	25	19	7273
	42	99	30	23	.6984
	49	93	36	28	.6809
	56	86	43	33	.6808
Columbia County... **(Large.)**	7	204		......	....
	14	192	12	6	
	21	175	29	14	.9814
	28	161	43	21	.9815
	35	150	54	26	9715
	42	139	65	32	9338
	49	130	74	36	.9778
	56	122	82	40	8220
	63	109	95	46	.7552
Columbia County... **(Small)**	7	152	....	...	....
	14	142	10	7	
	21	133	19	12	1.0099
	28	127	25	16	1.0143
	35	122	30	20	1.0174
	42	119	33	22	9990
	49	116	36	23	.9780
	56	113	39	25	.9475
	63	108	44	28	.9141
Maltese Blood.......	3	209	....	....	.9075
	14	193	16	7	.9549
	21	181	28	13	.9748
	28	169	40	19	.9939
	35	160	49	23	1.0020
	42	154	55	26	1.0024
	49	150	59	28	1.0024
	56	143	66	31	.9942
Improved Malta.	2	194	....	...	.9955
	9	187	7	3	...
	14	179	15	7	1.0152
	21	168	26	13	1.0267
	28	159	35	18	1 0288
	35	152	42	21	1.0257
	42	146	48	24	1.0054
	49	140	54	28	.9742
	56	130	64	33	.8979
Double Imperial	2	201	....	...	.9474
	9	194	7	3	
	14	188	13	6	.9651
	21	178	23	11	.9783
	28	167	34	16	.9884
	35	158	43	21	.9881
	42	149	52	25	.9773
	49	141	60	29	.9445
	56	129	72	35	8979
Indian River...	9	216	....	...	.9652
	16	210	6	3	.9698
	23	201	15	7	.9763
	30	193	23	11	.9713
	37	180	36	16	9665
Foundling..... ... **(Indian River.)**	9	207		....	.9918
	16	199	8	4	1.0069
	23	189	18	9	1.0052
	30	181	26	12	1.0092

APPROXIMATE ANALYSIS OF FRESH ORANGE.

BY J. J. EARLE.

	Majorica.	Jaffa.	Navels.	Maltese Blood	Imperial Malta.	Double Imperial.	Indian River	Foundling, Indian River.	Bitter Sweet.	Sour.	Columbia County.	Tangerines.	Mandarines.	Sprack's.	Select.	Average.	Average of all except select Tangerines and Sprack's Mandarines.	Average of select Tangerines and Sprack's Mandarines.
Weight of } in grammes	209 09	212.12	217 11	187.27	191 00	188 92	215.41	197 23	194.28	218 67	212.46	128 81	150 07	172.00	73.46	184 51	208 45	181.08
1 orange } in ounces	7.46	7.57	7.75	6 68	6 82	6.74	7 69	7 05	6.93	7.80	7 58	4.60	5 31	6.14	2.62	6.57	72.67	4.67
Peel, per cent	22 24	23.49	25 65	23 92	17.30	24 23	18.10	18 49	41.36	41.73	29 16	23.00	24 45	18 85	15 37	24.49	25.97	20.41
Seed, " "	1.11	76	.77	.95	1 24	.43	2 35	2 75	3.54	6 30	2.71	1 77	3.62	2.89	17	2 09	2.08	2.11
Pulp and juice, per cent	76.65	76.74	73 58	75.13	81 45	75.34	79 54	78.75	55.10	51 96	68 12	75.22	71.93	78.74	84.37	73 50	72 03	77.56
Total	100.00	99.99	100.00	100 00	99 99	100 00	99.99	99.99	100 00	99.99	99.99	99 99	100.00	99 48	99 91	100.08	100 08	......
Moisture, per cent	......	87.46	87.05	86.90	86 63	88.62	88.20	87 06	87.72	86.82	86 82	89 47	89 80	......		87 71	87 83	89 68
Nitrogen, " "	......	.081	.085	.100	.109	083	.112	.097	.173	.208	.176	.161	111	....	......	124	.121	.136
Organic mat'r, exclusive of nitrogen, per cent.	..	11 54	11 70	11 84	12.02	10.25	11 00	11 60	11 12	12 25	12 12	9.70	9 59	......	......	11 24	11.55	9.64
Silica, " "	......	.0175	.024	.008	.001	.001	001	.022	.008	.006	.010	008	.008	......		0097	.010	006
Sulphuric acid, " "	......	.0507	.054	.056	.065	.046	.024	.039	.048	.023	.035	.046	.026	......	......	.0420	.043	.006
Phosphoric acid, " "	..	.0777	094	.095	.116	088	.058	.097	.080	.056	082	.051	.018		......	0770	.083	049
Ferric oxide, " "	.. ...	.003	.005	004	012	011	.0 4	.002	.006	.004	.008	.009	004	.. ..	......	0060	.005	.006
Lime, " "	......	.1640	.277	.226	.228	.248	.219	.382	287	.236	142	096	.064	......	....	.2070	.232	080
Magnesia, " "	......	.0460	.040	.048	.059	.041	.086	.060	.054	.035	.056	.042	021	......	.....	.0450	.048	081
Potash, " "	......	5040	590	.659	.680	.571	.296	.499	.493	.284	.486	.380	.289	......	.. ..	4790	.506	.334
Soda, " "	......	0430	.046	.047	.056	.028	.022	047	042	.026	044	037	023	......	......	.0390	.041	080
Chlorine, " "	......	0090	.012	013	.015	.008	010	.018	.007	.004	.016	011	.008	......	......	.0110	011	009

QUANTITY OF FERTILIZER IN 1,000 ORANGES.

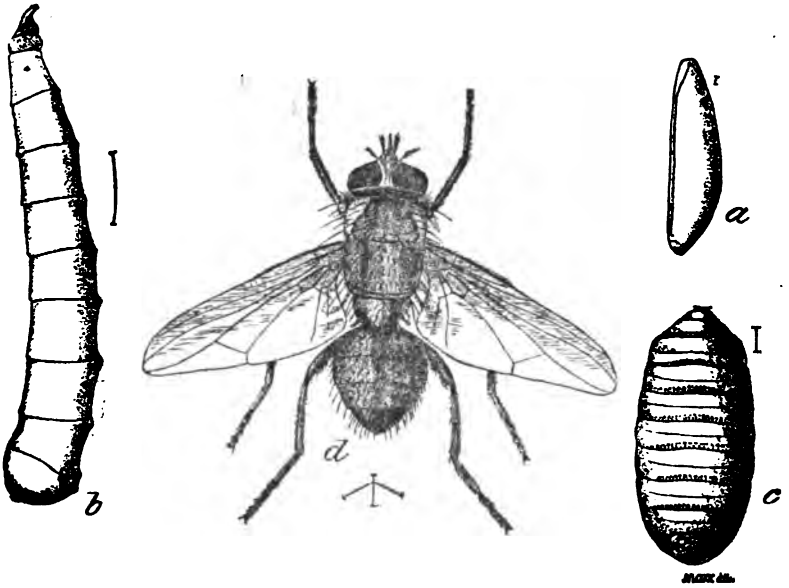
	Majorica.	Jaffa.	Navels.	Maltese Blood	Imperial Malta.	Double Imperial.	Indian River	Foundling, Indian River.	Bitter Sweet.	Sour.	Columbia County.	Tangerines.	Mandarines.	Sprack's.	Select.	Average.	Average of all except select Tangerines and Sprack's Mandarines.	Average of select Tangerines and Sprack's Mandarines.
Silica, in ounces	....	1.50	1.55	0 67	0.07	0 06	0.31	1 41	0.55	0.47	0 76	0.87	.43	......	.....	.68	.78	.40
Sulphuric acid, in ounces	......	3.80	3.90	3.70	4.30	3 10	1.80	2.70	3 30	1.80	2.60	2 10	1 80	....	....	2 86	3.10	1 70
Phosphoric acid, "	......	6.10	7 10	6 30	7 80	5 90	4.40	6 70	5.50	4 80	6 10	2 80	2.50	......	..	5 42	6.02	2 40
Ferric oxide, "	......	0.24	0.39	0.28	0.67	0.74	0 31	0.14	0.41	0.31	.061	0.46	0.21	......		.39	.41	.33
Lime, "	......	13.00	21.70	14.90	15 30	16.20	16.60	25.20	16.20	18.20	10.00	4.40	3 40	......	....	14 56	16.69	3 99
Magnesia, "	....	3.78	3.10	3.34	4.09	2.70	3.07	4.23	3.46	3.04	4 54	1.84	1.07	......	..	3.19	3 53	1.45
Potash, "	......	37 00	46 50	43 50	45 30	38.10	22.50	34.70	33.80	38.00	36.40	17.20	15.30	......	.. ...	34.07	37.63	16.25
Soda, "	......	3 03	3 87	3.34	4.09	2.02	1.53	3 52	2 77	3.04	3 06	1 84	1.07	.....	......	2.76	3 02	1.45

THE HORN FLY.

(*Hæmatobia Serrata.*)

This fly made its appearance in Florida some time last year or late in 1890.

As far as we have learned it was not troublesome in this State until last fall. Then it was abundant enough to annoy milch cows. This year it made its appearance as early as the first week of April. It may become a severe pest before the end of this year. Florida cattle running in hammocks and pine woods will suffer severely before the trouble will attract attention.



THE HORN FLY. Fig. I. The hair-lines show natural size: *a*, egg; *b*, lava; *c*, puparium; *d*, adult fly. (From blocks kindly loaned to us by officers of division of Entomology, U. S. Department of Agriculture.)

This fly is about a fourth of an inch long. In appearance it resembles the house fly, excepting that it is much smaller and little lighter in color. A rather sluggish insect in that it does not fly much.

When disturbed by a switch of tail or shake of horn it rises a foot or two above the cow and settles almost as quickly again.

When alighting to feed it parts the hair of the cattle and works its way down to the skin, making it appear as though it were "standing on its head."

Wings are constantly spread for flight, making it quite difficult to catch.

The name horn fly has been given to it from the habit of clustering on the base of horns while resting. It does this only when very abundant. It has also been called dog fly in this State.

The damage it has done has been variously estimated. In some places east it caused milch cows to loose one half in milk; others found it unprofitable to keep fattening steers.

It was first noticed near Philadelphia in 1887; from there it has spread rapidly southward. Last year it was taken in Georgia. It seems that it was imported from Europe about six years ago.

The eggs (see *a* fig. I) are deposited in cow dung while it is still fresh, usually not later than a minute after its dropping. Most of then are deposited during the day between 9 and 4, and mainly between 9 and noon.

LARVÆ.

The eggs hatch in twenty-four hours after depositing. The larvæ (see *b* fig. I) then descend into the dung, remaining, however, near the surface.

PUPARIUM.

When ready to transform, the larvæ descend into the ground from one half to three-fourths of an inch; here they transform into a puparium. (See *c* fig. I.)

In about two weeks from the time the eggs were deposited perfect flies emerge. (See *d* fig. I.)

REMEDIES.

Most greasy substances will keep flies off cattle, and that which is cheapest and not harmful to cattle would be preferable, providing it would be lasting.

Train oil or fish oil with a little sulphur and carbolic acid added has been recommended. Fish oil seems to be the most lasting substance used.

These remedies simply keep the flies off the cattle treated.

"X. O. Dust" will kill flies when brought in contact, but lasts only two days.

Professor Garman, entomologist, of Kentucky Experiment Station, recommends the use of finely powdered tobacco sprinkled about the horns and over the backs of cattle.

Wherever cattle congregate during the day thedung could be gathered into piles every three or four days, and the whole treated with lime or land plaster, or a spadefull of lime spread on each separate pile. In this way the larvæ would be killed.

We are indebited to Dr. Riley and his assistants for the complete knowledge of the life history of this insect.

P. H. Rolfs,
Entomologist.

QUESTIONS CONCERNING STOCK DISEASES.

The estimated value of the live stock in this State is placed at about five and three-quarter millions of dollars, of which three millions are represented in horses and mules and a little more than two million in cattle. Supposing the annual losses from disease to be no greater here than elsewhere, the amount must aggregate several thousand dollars. There are conditions present which add much to the loss occasioned by disease. In places the rearing of horses and cattle is attended with much difficulty, it being necessary to make importations to supply the necessities. These importations, as a rule, are of a cheap grade, and do nothing toward the improvement of the common stock. The acclimation of the finer breeds is attended with uncertainty, often resulting in much loss.

It is for the investigation of these unfavorable conditions and local diseases that the veterinary department has been instituted. That the department may most effectually serve this purpose, it is desired that the farmers will respond to the questions asked.

The two diseases on which we desire special information are "big-head" and "salt-sickness."

"Big-head," *osteo porosis*, is a bone affection of the horse and as its common name implies, is characterized by an enlargement of the head. The disease is not confined to the horse but is seldom recognized in other animals. Age does not confer immunity to an attack. Animals under seven seem to be much more susceptible to the disease than those that are older. Post mortem examinations show that the disease is not confined to the head, but all the bones of the body are affected. The greater apparent enlargement of the bones of the head is due to the close proximity of these bones to the surface and the enlargement due to the pressure exerted by growing teeth. Being a disease involving the entire skeleton there can be nothing to warrant the treatment now practiced and as often unsuccessful, of cutting into the jaws and inserting strong caustics.

The symptoms of this disease are noticed in about the following order: Weakness in the back, sluggish usage of the hind parts, inability to raise the fore-feet over an obstacle, difficulty in rising, thickening of the lower jaws and enlargement of the bones of the face. Finally the animal loses power of locomotion, lies down and usually dies. If the disease is slow in its course the appetite remains unimpaired and the coat unchanged in appearance until near death. Should recovery take place the enlarged bones remain a permanent mark. About twelve per cent. recover.

The questions desired to have answered regarding the disease are as follows:

When and where did you first observe the disease in this State?

What was the age of the animal?

What sex?

What season of the year?

What breed?

Was the animal of local raising or imported?

Have you ever observed an animal to have a second attack?

Have you observed the disease to appear in the offspring of animals used for breeding purposes?

What was the source of the water supply and character of the water?

Give data regarding the history of the animal, work, etc.

How many cases have you known to recover?

How many to die?

We desire a description of the disease called "salt sickness" as it exists in your locality. The many descriptions given make it seem probable that several diseases are being called by this misrepresentative term.

What are the most common diseases of the domestic animals in your locality?

The department will be glad to receive reports on any disease, and expresses a willingness to assist in controlling the same.

Prescriptions will be given applicants where the symptoms are clearly enough described to make a diagnosis.

BULLETIN No. 18

— OF THE —

EXPERIMENT STATION

OF FLORIDA,

— AT THE —

State Agricultural College,

LAKE CITY, FLA.

GRASSES,
FORAGE PLANTS,
TOMATO BLIGHT.

REV. JAS. P. DePASS, Director.

THE DA COSTA PRINTING HOUSE, JACKSONVILLE, FLA.

DEPARTMENT OF AGRICULTURE AGR'L COLLEGE.

J. P. DePass, Professor of Agriculture.
J. N. Whitner, A.M., Prof. of Pomology and Horticulture.
A. W. Bitting, B.S., Prof. Veterinary Science.
P. H. Rolfs, M.S., Prof. Botany and Entomology.
A. A. Persons, M.S., Prof. Agricultural Chemistry.
W. G. DePass, Assistant Agriculturist.

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This bulletin was written by Prof. P. H. Rolfs, at my request, because last year as botanist and entomologist of the station he had charge of subjects on which he writes.

JAS. P. DEPASS, *Director.*

GRASSES AND FORAGE PLANTS.

The experiments commenced about November 15, 1891, when W. G. DePass, Assistant Agriculturist, superintended the seeding of many species in a peach orchard. About January 1st, 1892, these were placed under my observation.

These experiments are by no means conclusive, but by direction of Director DePass, these notes have been collected for publication.

These experiments should be diligently continued for a number of years, and under various conditions. The success, however, in this very unfavorable year, encourages us in the hope that there will be forage plants found to meet the demands of our State. In selecting such a plant two points, feed and fertilizer, must be kept in mind.

These grasses are given in order of their success for this year.

HAIRY FLOWERED PASPALUM. (*Paspalum dilatatum, Poir.*)

[See Plate.]

As a result of this years experiment this grass stands at the head of the list. It combines several good qualities. *First.* It makes a good pasture grass, growing continuously throughout the year, and thrives well when run over by cattle. *Second.* It grows tall enough to make hay, the copious broad leaves growing more than a foot long. *Third.* This years experiment seems to indicate that it will grow well from seed. *Fourth.* The seed seems to be easily collected.

A small package of plants sent to the station were set out last fall. They were slow in starting, but when once thoroughly rooted they stood the frost and drouth without injury.

A small package of seed sowed January, 1892, have made almost as good sod as the roots set out in November, 1891.

This grass is a native of Southeastern United States and of South America. It grows from two to five feet high, with numerous leaves about a foot long and one-third to one-half inch broad. It does not creep upon the ground like some species, belonging to this genus but is inclined to grow in tufts. It has been recommended for pasture and for hay by persons in Texas and in Louisiana.*

The following statement of chemical analysis indicates that it makes good fodder and good fertilizer:—

Water, 14.3 per cent.; ash, 7.28 per cent.; fat 1.89 per cent.; nitrogen, free extract, 50.07 per cent.; crude fibre, 21.21 per cent.; albuminoides, 5.25 per cent.

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* *Cf. Vasey.* Agricultural Grasses and Forage Plants of the United States.

RAY GRASS. (*Arrhenatherum avenaceum*, Beauv). (*Avena elutior*, *L.*) This is a promising grass for winter pasture. It was imported from Central Europe, where it is much prized. It is known also as Randall grass, and evergreen grass. Some of the experiments with it are given below. The culims are two to four feet high, erect, with four or five leaves each. The leaves are six to ten inches long and one third of an inch wide. Panicle loose, from six to ten inches long. The structure of the flower is similar to that of the cultivated oats. The roots are perennial, making leaf-growth enough for a winter pasture as far north as in Mississippi.

EXPERIMENT I.—SEEDING IN ORCHARD.

Nov. 15—Sowed in drill between rows of trees in peach orchard.

Jan. 2—Good stand, fine color, large blade; very promising in appearance.

Jan. 17—Highly favorable growth.

Feb. 2—Looks well and making good growth.

Feb. 16—Continues to do well.

March 11—Claims ground in drill. Seed badly mixed.

April 4—Doing well.

May 31—Tall enough and sod heavy enough to make good grazing.

June 10—Growing even in severe drouth.

Nov. 19—Fine grazing sod; looking very green in contrast with the dry surrounding.

A SECOND PLOT WAS SOWN.

Jan. 28—Sowed in drill between rows in peach orchard, a portion fertilized with "station compost."

March 11—Good growth. Growth and size practically the same as that sown November 15, 1891.

Nov. 19—Good grazing sod. No perceptible difference in the fertilized and unfertilized.

EXPERIMENT II—SEEDING IN OPEN FIELD.

Jan. 29—Sowed in drills and broadcast, a portion of drills and broadcast fertilized with "station compost."

March 11—Heavy stand and fine growth in drills. Poor stand and poor growth on broadcast.

April 4—Making good growth.

May 31—Affected by the drouth.

June 10—Nearly all dead.

TRICHOLÆRNA ROSEA, Schrad.

This grass stood the drouth remarkably well, and has made a fine sod. In all respects it looks as though it might be placed at the head of our list; but the limitedness of experiment will not allow it to be placed higher.

Culms over two feet high; leaves long, soft, not hairy, and delicate. Panicle a fine rosy plume, about eight inches long, making an elegant showing as an ornamental grass. The first culms were sent up in July, and there are still (November 19) new ones forming. All this time there has been vegetation enough to make a good crop of hay.

The seed was obtained from the Department of Agriculture. Dr. Vasey says the grass was imported from the Cape of Good Hope, Africa.

ERAGROSTIS CAMPESTRIS, Trin.

During last winter frequent excursions were made to collect sets of native grass to introduce into cultivation.

The above named grass was among those collected. It grew well, and made an excellent growth on poor, dry land. So far it seems to be a good summer grass.

TEXAS BLUE GRASS (*Poa Arachnifera*, Low).

This grass holds up its former reputation, and proves itself thoroughly reliable as a lawn or pasture grass, but t is not meeting with great favor, because it fails to produce a stand from seed, and to plant a field with sets is too much work.*

BROWN BENT GRASS (*Agrostis canina*, L.)

A low grass, with slender culms and expanded panacles, growing in mountainous regions of the United States and Europe. In these regions it forms a close sod and affords a good pasturage.

EXPERIMENT 1—SEEDED IN ORCHARD.

Nov. 15.—Sowed in drill between rows of trees in peach orchard.

Jan. 2.—Heavy stand but the individual plants rather puny.

Jan. 17.—Good stand; plants making no progress in growth; color good.

Feb. 2.—Doing quite well.

Feb. 17.—Good stand, leaves spindly, of good color.

March 11.—The seed had not been well cleaned so the foreign seed grew and crowded the bent grass down to a considerable degree.

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*Last year the season was uncommonly dry and it is possible that this caused the seed to fail. Director De Pass' experience in getting plants has been successful. (See p 18 Bulletin 16).

April 4.—The bent grass doing well in spite of the "weeds."

May 5.—Fair sod.

June 10.—Suffering from by long drouth.

Nov. 19.—Making a good sod and will probably give pasture.

EXP. II—SEEDING IN OPEN FIELD.

Jan. 29.—Sowed in drills and also broadcast, a portion both of drills and of broadcast fertilized with "station compost."

Feb. 27.—Plants coming up.

March 11.—Good stand in drills. Very heavy stand in broadcast. The portion fertilized showed decided advantage over the unfertilized.

May 5.—Growing and making a fair appearance.

June 11.—Killed out by long continued drouth.

BENT GRASS (*Agrostis alba*, L.)

This is known by several common names, among them are Fiorin, Redtop, Finetop; also several different scientific names have been applied to it. (*A. stolonofera*, *A. vulgaris*, Vasey, p. 77, Vol. III., No. I Contb., U. S. Nat. Museum).

It grows two or three feet high from a creeping root stock. The sod of this grass is firm and tough when once formed. It is a valued grass at the North, and has been reported as doing well in Louisiana.

While it attains its best in moist rich land it is by no means restricted to that kind of land.

EXPERIMENT I.—SEEDING IN ORCHARD.

Nov. 15—Sowed in drills between rows of trees in peach orchard.

Jan. 2—Much like brown bent grass.

Jan. 17—Making better growth than brown bent grass.

Feb. 2—No better than brown bent grass.

Feb. 16—Same as brown bent grass.

March 11—Less progress than brown bent grass.

April 4—Slow growth.

May 4—Died out in drier places.

June 10—Part lived through spring drouth.

Nov. 19—Making sod, and may grow enough for winter pasture.

EXP. II.—SEEDING IN OPEN FIELD.

Jan. 29—Sowed in drills and broadcast. A portion of drills and broadcast fertilized with "station compost."

March 11—No plants up in drills; a heavy stand in broadcast plot.

April 4—Fair growth. Fertilized portion better than unfertilized.

May 10—Dying from drouth.

GOLDEN OATS (*Avena flavescens, L.*).

Where this grass is able to grow it makes a valuable fodder.

EXPERIMENT I—SEEDING IN ORCHARD.

Nov. 15—Sowed in drills between rows of trees in peach orchard.

Jan. 2—Stand good; especially the moister portion.

Jan. 17.—Making fair growth; good color.

Feb. 2—Fair growth and color.

Feb. 16—Making fair growth.

March 11—Good growth. The seed badly mixed.

April 4—Growth good.

May 31—A good sod formed; growth continues.

Sept. 20—Unfortunately the plot was moved over so the seed was lost and the identity is doubtful.

Nov. 19—Growing and forming a grazing sod.

CYNOSURUS CRYSTATUS, L.

Introduced from Europe. In cooler portions of the United States it is spoken of as a tender fodder grass.

EXPERIMENT I--SEEDING IN ORCHARD.

Nov. 15—Sowed in drill between rows of trees in peach orchard.

Jan. 2—Good stand and good color. Plants small.

Jan. 17—Making slow progress.

Feb. 2—Better growth and color.

March 11—Very slow progress.

April 4—Plants spindly and poor color.

May 31—Alive but small.

Nov. 11—Growing.

EXP. II—SEEDING IN OPEN FIELD.

Jan. 29—Sowed in drills and broadcast in an open field. A portion of drills and of broadcast fertilized with "station compost."

March 11—In drills, good stand and fine growth. In broadcast good stand and fair growth.

April 4—Being killed by drouth,

May 31—Killed by drouth.

These experiments were duplicated four times in peach orchard and twice in the open field.

In the orchard duplicate plots of all seeds on hand were sowed about January 2d, January 15th, February 4th and March 1st. In the open field one set of plots were sowed January 28th, another February 14th and another March 1st.

Besides these another set of experiments were carried on by sowing the seed in a field of oats.

It was hoped that the oats would afford some protection to the young plants, but the drouth was too severe last summer even for the oats.

In all nearly two hundred experiments were tried.

SUMMARY.

A great many seeds failed to produce plants.

A great many young forage plants cannot stand a severe and long continued drouth.

Considering all points of the grasses that lived until November 19th, the following is a provisional order of their values:

(1) *Paspalum dilatatum;* (2) *Arrhenatherum avenaceum;* (3) *Tricholæna rosae;* (4) *Eragrostis campestris;* (5) *Poa Arachnifera;* (6) *Agrostis canina, etc.*

The four brome grasses (*B. inermis, B. molles, B. pratensis and B. uniloides*) seeded, all grew well and matured seed but would not make pasture nor hay. The seed was badly mixed. Schrader's grass (*Bromus uniloides,* Kurth) that has been recommended was very poor.

List of species that produced plants but failed to mature:

Sweet Vernal Grass—	*Authoxantum adoratum,*
	Avena steralis,
	Cenchurus Montana.
	Eragrostis diandra,
	Eriochloa aristata,
	Glyceria nervata,
	Panicum frumataceum,
	Panicum Palmerii,
	Pennisetum cenchroides.
Texas Blue Grass—	*Poa arachnifera,*
	Phalaris cœrulescens.
Latharis—	*Lathyris sp.*
Kidney Vetch—	*Authyilis vulneris.*
White Melilot—	*Melelotus alba.*
Medick—	*Medicago sativa.*
Smaller Medick—	*Medicago media.*
Red Clover—	*Trifolium pratense.*
Mammoth Clover—	*Trifolium pratense var perenne.*
Crimson Clover—	*Trifolium incarnatum.*
White Clover—	*Trifolium repens.*
Japan Clover—	*Lespedezia striata.*

A small plot of white clover has been observed almost daily since last March. It seems to be an accidental patch under water oaks. While other plants have failed to live this has produced blossoms and made sod in spite of being constantly grazed.

Fifty-four species were sowed that produced no plants. These failed either for the want of proper condition or because the seed was bad.

TOMATO BLIGHT—SOME HINTS.

This disease is causing considerable loss in parts of Florida, and is doing much damage in other Gulf States.

The blight can be easily distinguished from other diseases of the tomato. The first sign is wilting of a single leaf near a head, as if it were suffering from drouth. Soon other leaves are involved and rapidly, in warm weather, the whole head shows similar wilting. There are no spots, no downy outgrowths; no other signs of disease.

The time elapsing between the first appearance of the disease and the death of the plant depends on atmospheric conditions. I know of no case where the plant recovered from an unmistakable attack.

During last year's study on this disease a good many interesting facts were learned. The most important ones may be put to practical use in the form of several "dont's."

1. *Don't* plant tomatoes on land that had blight on it last year.

2. *Don't* plant (1) summer cow-peas, (2) summer squash, (3) cabbage, (4) egg plants, (5) Irish potatoes, (6) musk melons nor (7) water melons on land infested with blight.

3. *Don't* let a plant grow a minute after it shows signs of blight.

4. *Don't* pile plants that were blighted. Dry separately and burn.

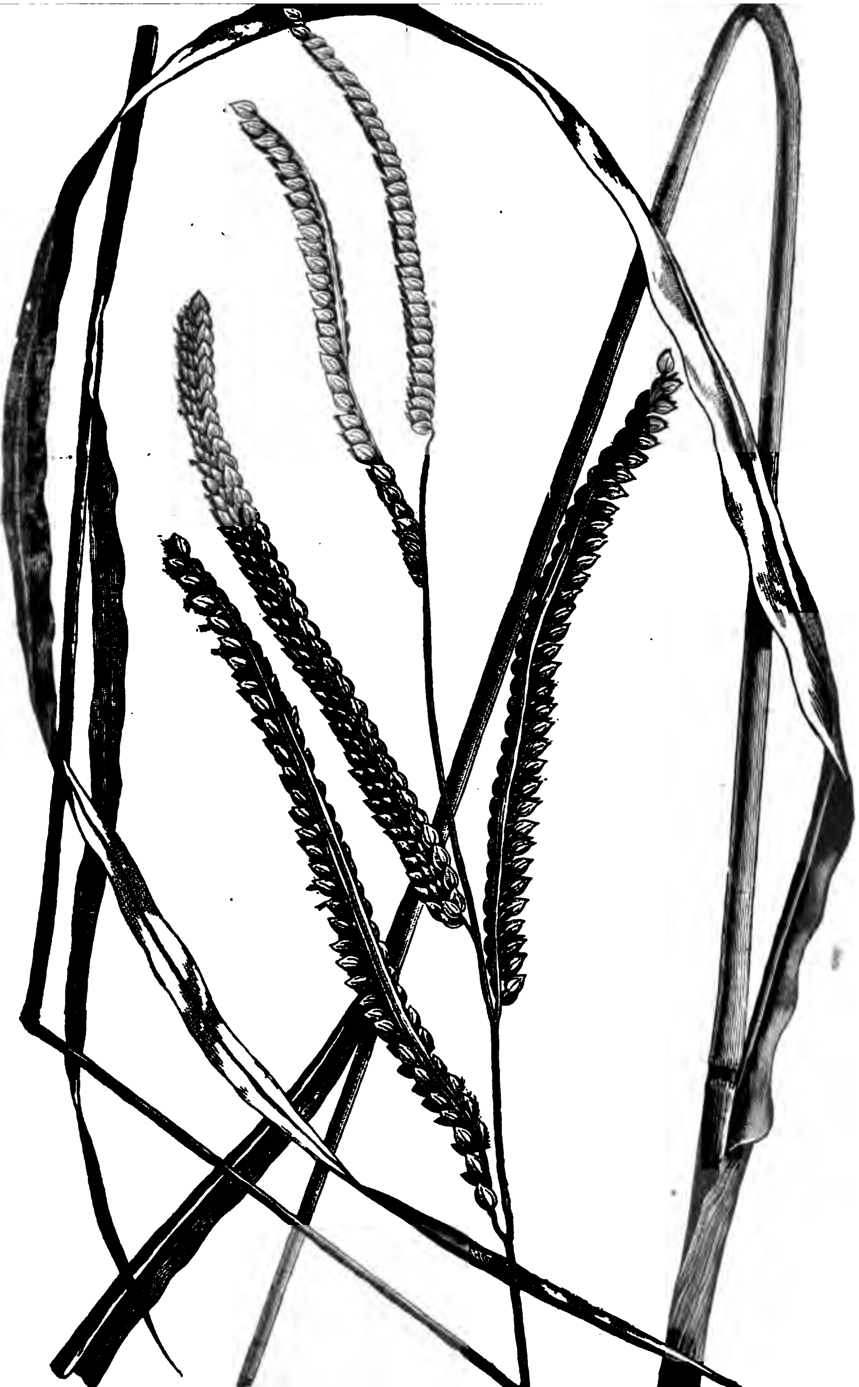
5. *Don't* move a vine that has been killed by blight, burn it on the spot.

Eight different experiments with as many different fungicides were tried and all gave negative results. It is intended that these shall be continued this year.

Specimens of diseased plants will be gladly studied and replies to questions cheerfully furnished. In sending specimens please wrap in such a way that they will keep green until they arrive here.

Specimens have been liberally furnished by persons in various portions of the State, but the interest in their section prevents my mentioning them.

P. H. Rolfs,
Prof. Botany, F. A. C.



BULLETIN No. 19,

OF THE

EXPERIMENT STATION

OF FLORIDA.

AT THE

STATE AGRICULTURAL COLLEGE,

Lake City, Florida.

1892.

REV. JAS. P. DEPASS, DIRECTOR.

SAVANNAH, GA.:
THE MORNING NEWS PRINT.
1893.

AGRICULTURAL DEPARTMENT

—OF—

A. & M. COLLEGE.

JAS. P. DEPASS, Prof. Agriculture.
J. N. WHITNER, Prof. of Horticulture and Pomology.
A. A. PERSONS, Prof. Agricultural Chemistry.
P. H. ROLFS, Prof. Botany and Entomology.
A. W. BITTING, Prof. Veterinary Science.

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TOBACCO.

The increasing interest in the culture of tobacco throughout the State and the demand for literature on the subject, induces me to prepare this Bulletin in the interest of the inexperienced grower.

THE PREPARATION OF SEED BED.

Prepare seed bed the first week in January. If land is new rake off all trash, digging up carefully all roots. Break up land deep either with spade or hoe if beds are small, if large with plow, but do not turn under the top soil too deep. If the land is old hoe off all grass and weeds before breaking it up.

The seed bed should have some exposure to sun and be near water. Wet or springy land is not good unless well drained. A bed in the open forest where sun, shade and water can be had as needed is the best selection. New land, in some respects, is better than old, but it should be manured whether burnt or not. Old land can be burnt over and then fertilized, but the experience on the Station does not demonstrate that the burning of land for a seed bed is of any other advantage, when the soil is prepared well and made rich by fertilizing, than the destruction of weed and grass seed, which can be picked out cheaper than by burning. The bed should be made smooth with one side slightly higher than the other in order to shed water. The beds should be made narrow and so trenched that if it became necessary to water, the trenches could be used to hold the water, and in this way allow the beds to become wet by soaking in.

FERTILIZER FOR BEDS.

Decomposed or fresh stable or cow manure, cotton seed meal or crushed cotton seed, or rotted cotton seed, are good. Quite a number of commercial fertilizers prepared specially for tobacco have proven good. Almost any of the standard fertilizers for vegetables, in the absence of others, would serve, *observing this, make the bed rich.* The intelligent farmer who knows his soil must be the judge. Apply your fertilizer *a month before sowing* and when applied do not put it deep, but on *top of the bed.* It may be raked in but if so, barely cover it. The young plants need the fertilizer at once and it must not be put beyond their reach.

SOWING THE SEED.

Seed sown earlier than February or the first of March in Northern Florida are not likely to be of service unless protected from cold winds and frosts. The best results for early planting have been obtained on the Station by sowing after the middle of February to the latter part of March. Seed have been sown on the Station as late as 19th of June and planted on cabbage patch 12th of July and a good crop of first-class tobacco raised. Broadcast or sow in drills. If in drills raise the beds so that in case the weather becomes dry water can be poured between drills without injury to plants by caking the earth around them. On dry sandy land I advise drills, although it will require a larger area for bed and more labor.

If seed are either sown in drills or broadcast, cover very shallow and roll the soil or press it with the hand. Seed lightly brushed and then rolled is as good if not the best way to get them up.

The bed should be moist enough to sprout the seed and kept so.

After the bed is sowed cover it with brush which serves as a protection against frosts and beating rains.

QUANTITY OF SEED.

The quantity of seed to sow depends upon the area to be planted. One oz., if a good stand is had, will furnish plants for three acres. It is not safe, however, to be governed by such a rule. The tobacco seed are so small and the plants so tender and tiny when they first come up as to make them of all seeds and plants the most easily killed or injured. If seed are covered too deep, or if the ground is allowed to become dry after they have sprouted, they will die. Again, insects may destroy them in a day. Seed may come and the stand be good, and they may be the prey of insects, or be dried out by the sun. Again, plants may come and the fertilizer, not having been put in the soil long enough, may burn them up directly. In view of these facts, and possibly others, it is well to have on hand sufficient seed to provide against these contingencies or accidents. Again. No one should depend upon one sowing. The first should be followed by another every week or two, not only as a protection against accident, but to have fresh plants with which to supply missing places in the field, for which purpose they are always needed.

One oz., mixed thoroughly in three quarts of fine meal, will sow broadcast 100 square feet. The meal indicates whether you have evenly sowed the bed.

A hand roller can be made by sawing off a log, which is from six to eight inches thick, and making a frame with handle to it, or it can be used where beds are small without. In place of a roller, the hand, or a board may be used to press the dirt to the seed.

WHAT KIND OF SEED TO SOW.

The common impression prevails that Cuba seed, after they have seeded here a year or longer, are better than freshly imported seed; that they make a better wrapper, &c. This has not been the experience of the station. Fresh imported seed have grown as large leaf, as good wrapper and filling, and in every way done equally as well as those which have been in the State from one to five years.

WATERING.

A great many tobacco beds are ruined by improper watering. To properly water is of the utmost importance. The object sought is to water so as not to pack the earth either on the seed or around the growing plant. A simple contrivance is a barrel placed on a stand eight or ten feet above the bed and to one side. In the bottom of this barrel insert a ¼-inch pipe that will reach near the ground. To this attach a hose long enough to reach the centre of seed bed. Attach the hose to a pointed stick, to support it in middle of bed, and in the end place a revolving sprinkler and turn the water on. This will give results as near a light rainfall as can be obtained. Other methods can be used, such as the common rose sprinkler or sprayer. If beds are made narrow and the trenches kept intact the trenches can be filled with water and allowed to soak through beds.

The best time to water is in the evening, beginning early enough to allow time to place sufficient water on beds, so that they will not dry out the next day. Sometimes whole beds, during a dry time, are killed by not wetting the bed sufficiently so that they will retain moisture during the following day. The beds should be watered daily and kept up until the plants are large enough to do without it.

SIZE OF PLANTS TO TRANSPLANT.

Plants are large enough, if the season is good, to take from bed when they have four well developed leaves, even though they may spread on the ground. The best size are those from four to six inches high. Still plants that are from eight to twelve inches have been used successfully by making the hole deep enough, so that from four to six inches of the plant is left above ground.

In transplanting, and if done by hand, even if the season is a good one, it will pay to water each plant a little, so as to settle the earth to it.

If the season is good, they can be dropped and planted like cabbage plants, and they will live and grow off as readily.

ENEMIES.

The seed bed has its enemies. They are not an uncommon cause why there is a failure of plants. Seed, often good, are ruined by them while sprouting, and plants after they have come up. Among the most destructive is the flea beetle. This little pest will not be noticed unless it is hunted. About the size and color of a flea they assail the seed sometimes as soon as it sprouts. Again, the bed is green with innumerable plants one morning, when in a few days but few, if any, survive.

Another insect, popularly known as a leaf hopper, and belonging to the locust family, was observed on the leaf by Prof. Rolfs, the past season. Its color being very much like the leaf, it is not likely to be noticed. It injures by sucking juice through epidermis of the plant. If they should come in large numbers they would do great damage.

The cut worm is also destructive to plants in seed bed.

There are other insects also, we are led to believe, which destroy plants, and which thus far we have not identified.

Experience, this season, teaches us that our greatest enemy, the bud worm, attacks the plant in the seed bed. It does not, however, do so until the plant has developed several leaves. But it is certain that it does sometimes its most destructive work before the plant is transplanted in the field.

REMEDIES FOR ENEMIES.

Every person who grows tobacco should provide himself before planting with paris green to protect himself against the ravages of these pests. I give a few formulas which have been found to be effective in destroying them.

FOR FLEA BEETLE.

Take 20 gallons of water and mix it in 2 lbs. of lime. Allow the lime to settle, then draw off the water and add 1 oz. of paris green, mixing well. Spray the bed with this after planting the seed, stirring well before using, and the plants as they are coming up, and until they are an inch or two high.

1 oz. of paris green to 20 gallons of weak soapsuds may serve as a substitute, but is not as good.

CUT WORMS.

If the plants are attacked by cut worms, take 1 oz. of paris green and mix well with 4 lbs. of common flour or fine corn meal. A common tin box, perforated with a nail, will serve as a duster. With this dust he plants and the ground between.

Wherever stable or cow manure is used, or muck, or if the ground is rich, you may expect the cut worm, especially if the stable or cow manure has been exposed. Instinct leads the moth or fly to deposit its eggs in these, and when placed in bed or field the eggs are hatched and we have the worm. This remedy will apply to the field as well as the bed. This worm appears sometimes the day after transplanting.

BUD WORM.

The bud worm is very small and the fly or moth lays its eggs in the bud of the growing plant. When these buds put out the leaf is badly cut or full of holes, rendering it useless for wrappers and only fit for fillers.

In the seed bed the remedy should be applied as soon as the plant has attained about two inches. In the field the application should be made every few days and to the growing bud. If, after an application, a good shower of rain falls, it will be wise to go over the bed or field, as the rain may wash the remedy off.

The same mixture for cut worms is the remedy for the bud worm, and it can be used by dusting the bud of the plant.

THE HORN WORM

does not trouble the bed but assails the plant in the field when it is well grown. Its appearance is indicated by its eggs being laid on the under side of the leaf. It is well to keep a sharp lookout for them about May. These must be picked off by hand. Chickens, guineas and turkeys, if they have the run of the field feed largely on this worm and do not damage plant. Wasps, dirt-daubers, hornets, yellow-jackets and all similar insects are great feeders on the worms which assail tobacco and should never be killed. They are the farmer's friends and should be protected. The small boy ought to be taught that the wasp, the hornet and the yellow-jacket should never have their nests destroyed. It would be economy where farmers have no clay around their wells or horse troughs to haul it there and thus furnish the dirt-dauber the means of building his house, and thus encourage it to make its home with him even if he did not plant tobacco. The same is true of the other friendly insects; encourage and protect them so that they may multiply, for they are of great value to the farmer.

TOBACCO LAND

should be either sandy or that which has a sub-soil of clay one foot or more below the surface. Where the clay is on the surface it is not regarded as good tobacco land. Still there is land designated as clay which has a preponderance of sand in it. Such land I would not hesitate to plant tobacco in. As a rule any land which will bring a fair crop of corn or cotton, whether they be high lands or low, experience demonstrates, are good tobacco land in Florida, provided the high land is not springy, or the low too wet, both of which have made good tobacco the past season when properly drained.

Low or flat lands should be broken up and then bedded when ready for fertilizer. The rows should run in the direction of the natural drainage. NOTE.—"Sandy lands" is used as the common term in Florida to designate the character of our soils. All soils which are not clay, or largely mixed with clay, are called generally "sandy lands."

TO PREPARE LAND FOR CULTIVATION.

The farmer should begin early. The first of January is late enough to prepare land for a tobacco crop. If weedy and grassy a two-horse plow should be used to turn under. If before breaking up, a two-horse cut-away harrow is run both ways over the field it will be of very great advantage. After breaking up, a cut-away, or a smoothing, or sharp tooth harrow, or a heavy brush, should be used to level the ground. In this condition the field should remain until ready for fertilization, which should be done at least a month before transplanting. If fertilizer is broadcasted, harrow it in. If placed in drills, open with six-inch shovel and distribute it evenly and then cover with two furrows.

When ready to transplant from seed bed level the drills with harrow running up and down the rows and then plant. Harrowing at this time, whether manure has been put in drills or broadcast, kills both weeds and grass and destroys a great many seed of each which have germinated. Rows are laid of 4, 3½ and 3 feet apart. I prefer the latter distance. Plants are placed in drill from one to two feet apart. I prefer from one foot to fifteen inches if the soil is rich enough, and it should be made sufficiently fertile.

IN FERTILIZING

care should be taken to make the land rich. The planter should not be economical here. From 1,000 pounds to four tons per acre should be used according to the quality of the land and the quality of the manure. If stable or cow manure, from four to ten tons will not be too much if the soil needs it. If commercial fertilizer, less should be used according to the grade. See inductions under the head of Analysis.

THE METHODS OF CULTIVATION.

The tobacco plant grows off very quickly, and the spread of its roots is very rapid. The lateral roots run very near the surface, and the cultivation of the plant should necessarily be shallow. A Planet, Jr., cultivator or a wide sweep are good tools to use. In grassy land it will be necessary to hoe once and possibly more. The plant must be protected from grass and weeds.

In plowing it is better to throw the dirt slightly to the plant and thus form a low bed in the row. Three or four plowings and one hoeing in grassy land is usually sufficient work to make a crop and in new land less. It may be only necessary for the last working to run, very shallow, a sweep through the middle of furrow to kill young grass.

TOPPING AND SUCKERING.

There is a difference of opinion as to the time the plant should be topped. The Station is experimenting on this point, but has not decided it so far by sufficient testing. The generally prevailing opinion is that when the plant forms its blossom buds they should be pinched off. At this time the plant has formed from 12 to 16 and even more leaves. After topping, sprouts begin to shoot out from stalk where the leaf joins it. These should be pinched off and not allowed to grow longer than two or three inches. As these sprouts grow very fast, sprouting should be very closely looked after. Care should be taken not to pinch off the sprouts below the bottom leaves, and as the bottom leaves are not as a rule the best, it may be well not to take off the sprouts for the first two. From these sprouts below the bottom leaves, and which come out above the two first, is where the second, third, fourth and even later crops are gathered.

HARVESTING

is very irregular. From the time it begins until the crop is gathered, it is daily work. This work embraces the period from the first ripening to the last. Tobacco begins to ripen from six weeks to two months after being transplanted.

The best way to harvest is to cut the stalk when ripe near the ground with a sharp knife. In doing so avoid cutting off the suckers or injuring them. This should be done by bending with the left hand and cutting from below up. The leaves should not be stripped from the stalk. Care should be taken not to allow sand to get on the leaves, as it very generally injures the sale of the crop. If the plant has not begun to sucker when cut it will very soon do so. Three or four suckers, if the plant is healthy and the soil good, should be allowed to grow. The second, third and fourth crops should be treated in the same way. The fourth crop is a small one but the leaves serve as a filler, or for smoking tobacco, and if gathered it makes an excellent fertilizer. The stalks should all be saved for this purpose and are valuable with which to mulch fruit trees. It will very greatly increase the third and fourth crop if cotton seed meal is worked around the plant after the second cutting or even the first. The great trouble with inexperienced growers is to determine when the tobacco is ripe. Experience, however, soon settles this matter and it is not difficult to learn. The novice ought not to be deterred from planting because of the want of this knowledge. Color of leaves does not prove the best rule to determine the ripeness of the plant, although when the leaves begin to lighten in color or spotted it is a good sign. A better rule is that when the leaves are doubled and pressed between the fingers, they will snap.

THE CURING SHED OR BARN

may or may not be a costly building in our climate. For those who are beginners it is not necessary to build a barn especially for the purpose if there is a gin house on the premises or a log house that can be used. I have seen the very best quality of tobacco cured in a log house, the joists of which were not six feet above the floor. A common wagon shed will serve the purpose to begin with, if closed on the sides by rough-edge boards. The tobacco crop of the Station is cured in the upper part of a wagon and tool house. A great many persons will doubtless begin the cultivation of tobacco by planting from one-half to five acres. In their interest the above is written. For those who are determined to make it their business and who wish to build barns they can do so cheaply with rough lumber.

The points to be observed are, ventilation when needed, and the shutting it off. There should be doors at each end of the barn large enough to drive a wagon through. There is no necessity for a wooden floor, but the sills ought to be laid on brick or rock in our climate to prevent rotting, and the space between the sills and the ground closed with plank. Frames from the top to the bottom should be built inside on which to place poles or laths on which to hang the tobacco to dry. A sharp hollow spear that will fit a lath, made sharp enough to pierce through the stalk should be used. The stalk pierced and slipped on the lath or small pole and repeated until the pole is full, not allowing the leaves to touch each other, and then put in place on the frames, is the cheapest, easiest and most expeditious way of hanging tobacco in the barns. It, however, may be tied by strings to a pole, or with a knife a slit may be cut in the stalk and one end of 'the small pole or lath may be sharpened and pushed through, but these methods are both costly and tedious. Care should be taken to economize all the space possible, and the number of stalks to each lath or pole is to be settled by the distance of frames apart on which they are to rest. A shed 30 by 60 feet and from 10 to 14 feet high is sufficiently roomy to cure five or six acres of tobacco. Persons who desire to build fancy barns can do so, keeping in view the necessity of ventilation both above and below.

PREPARING THE CROP FOR MARKET.

The leaves are ready to strip from the stalk when the stems are sufficiently dry so as to show no sap when pinched. Before stripping, however, the leaves should be moist enough so that they will not crumble or break in handling. If the weather is dry the tobacco becomes very dry, but by giving it ventilation at night bv opening doors and windows, or during a rain, the condition can be obtained for handling. A north or a northwest wind dries tobacco very rapidly. When they blow shut up the barn.

In assorting, the top and bottom leaves and those which are ragged should be put to themselves and tied into bundles ranging in number from twenty-five to fifty according to size. These are for fillers. The better leaves should be assorted according to size, and tied in bundles or hands from twenty to thirty each. These are for wrappers. In stripping tobacco the leaves should not be smoothed out by the hand, but put into bundles just as they are on the stalk. It is the habit of some to make three grades, wrappers, binders and fillers. Binders are those where the leaves are in part free from holes.

The different grades should never be mixed in packing, but kept to themselves. In packing into boxes or bales the tips should lap each other and care should be taken to pack firmly and evenly. The ends of the packages should not touch the box sides, for ventilation is needed here to some extent to prevent moulding. When boxed keep on a board floor and under no circumstances allow the box or package to remain on the ground, or in close proximity to kerosene, commercial fertilizers, or obnoxious scent. The boxes should be as light as possible and uniform in size, but the dry goods boxes of merchants serve an excellent purpose.

BULKING THE CROP.

I mean by bulking that the farmers of a county would, I think, find it to their interest to store their crop in their county town for assortment and sale, securing or building a house for this purpose. An expert should be employed who will carefully resweat, assort and bale the tobacco in the same way as the Cubans do. It would be better to take the tobacco to an expert to be sweated just after it is stripped and assorted, than to wait until it has passed through the barn sweat. Wrappers, binders and fillers should be packed and sweated to themselves. In this way the crop would realize more money, amply repaying the cost of expert. On this line much could be said.

EXPERIMENTS OF 1892.

A large number of experiments were begun this year both in the seed bed and field. The objects in view were:

1st. To find the best method of raising plants.

2d. The use of various kinds of fertilizers, as to their effect upon texture, quality and quantity per acre, embracing soft and hard phosphate, potash, nitrogen, single and in various combinations, commercial fertilizers of different brands, and composts made on the station. These composts were in part based on the analyses of Cuba soil and Cuba tobacco, as given below.

3d. To test the quantity and texture of tobacco cut and cured at different stages of growth, the distance between rows and the space plants should have in drills.

The season was most unfavorable to success since from the first of January to the 29th of May there was no rainfall at any time sufficient to lay the dust. It was with much trouble that plants were grown, and when transplanted to get them to live, water them as much and often as possible. But by reason of much trying we succeeded in getting quite a number of experiments in good shape, considering the dry season.

On the 29th of May, when one experiment was just ready in which to commence the harvest, a tornado, followed by an unusually hard rain and hail, destroyed it and every other tobacco experiment in the field, as also the seed beds to a large extent. The result was that only the naked stalks were left. This storm was so severe as to entirely wash away the soil and fertilizer of another experiment. With what was left us we did the best we could under the circumstances, on which a report is made below.

In March we made a trip to Cuba in the interest of tobacco culture. While there we learned that the methods of culture differed from ours, not only in the distance between the rows, but the distance between plants in drill. It was observed, also, that the plants were topped at an earlier stage of their growth, and that they were taken from the field, being considered ripe by different signs and conditions than those governing us. As near as we could, under the unfavorable circumstances, we tried to gather and cure our experiments, which were mainly from second growth, by the Cuban rule. The only thing left us was to test the quality of texture and flavor. This tobacco, in connection with lots from different parts of the State, we have resweated and manipulated, by the assistance of a gentleman employed for the purpose, a native of Cuba, and we had segars made from it and tested, and the uniform testimony is, from different persons capable of judging, living in different parts of the State, that they will compare favorably with the best made from Cuba tobacco.

The other samples from other parts of the State have also been similarly tested and pronounced to be of very fine quality. It is conceded that resweating and betuning very greatly improves our Florida tobacco after it has passed through the barn sweat. The uniform testimony of segar manufacturers is that our Florida tobacco is not ready for them as it is prepared by our growers. Being apprised of this, for nearly two years or more, it was with the object in view, that of learning the methods of preparing segar tobacco for market as the Cubans do, that we sought a man who understood the process, and from him learn it, in order to teach it to our agricultural students, and also to those farmers who felt sufficient interest in the industry to undertake the necessary course. To give the process to the public would gratify curiosity and possibly induce some to attempt to sweat and betune their own tobacco. This might mislead and be attended by loss. Like everything else of value and importance the knowledge has to be attained by patient care and attention, and also by diligent application to the details. For these reasons it would be better to wait the process of further experiment and thus obtain a more accurate and thorough knowledge before it would be wise to try and teach the farmer the process by means of bulletins. The fact that the farmers generally do not know how to prepare their tobacco for market, and the difficulties in the way of their learning, will necessitate the establishment of sweating houses in every section of the State, convenient to growers, and those houses must be in charge of men who understand the art of sweating. Until the farmer learns how to prepare his tobacco for market those who understand the business must do it for him. The present crop, for which there is, at this writing, no demand, should be resweated, and it does appear that unless it is thus handled there will be no demand.

The station is preparing the next season to make a large number of experiments in tobacco, and on a more extended scale than heretofore.

It is supplied with a **Bemis Planter**, which opens, plants, waters, and covers at the same time. This machine has been thoroughly tested this year and found to be very successful in every respect. It will pay for itself in the saving of expenses in a single season in a crop of from six to ten acres. It is also equally as well adapted to planting all plants, such as cabbages, &c., as tobacco, and I very readily commend it to our tobacco as well as our vegetable growers. Mr. C. C. Chapman, who made a very fine crop of tobacco this past season near this place (Lake City), used one of these machines, which I saw operate frequently. He planted regardless of drought, and his heaviest loss from any one planting was not larger than 10 per cent. After having become accustomed to its use his loss was reduced to 5 per cent. Those who expect to make the growing of tobacco their business in the future should by all means supply themselves with this admirable machine for transplanting.

ANALYSIS OF STATION AND CUBA TOBACCO SOIL AND CUBA TOBACCO.

The soils of which the following analyses were made were taken from Station Plots, on which the experiment was made the past season, and also from a tobacco field in Cuba.

The tobacco analysis was of tobacco that had ripened on the Cuba soil.

The analyses were made by Dr. J. J. Earle, Prof. of Chemistry in Agricultural and Mechanical College.

SOIL ANALYSES.

Column One—Fla. Soil.

" Two—Cuba Soil.

	One.	Two.
Moisture at 110°	1.00 per cent.	14.20 per cent.
Organic matter	.95 " "	12.80 " "
Sand and insoluble matter	97.00 " "	30.32 " "
Carbonic acid (CO_2)	....	4.20 " "
Sulphuric acid (SO_3)	.007 " "	.12 " "
Oxide of iron (Fer O_3)	.790 " "	29.40 " "
" " lime (CaO)	.130 " "	7.60 " "
" " magnesia (Mg O)	.008 " "	.17 " "
Phosphoric acid (P_2O_5)	.053 " "	1.60 " "
Potash (K_2O)	.018 " "	.16 " "
Soda (Na_2O)	.030 " "	.084 " "
	99.98 per cent.	100.15 per cent.
Nitrogen to	.028 " "	.82 " "
Ammonia	.034 " "	.39 " "

The suphuric acid is combined with the lime to form sulphate of lime (gypsum.) The remainder of the lime is combined with the carbonic acid to form carbonate of lime, and with the phosphoric acid to form *phosphate of lime.*

CUBA TOBACCO STALK.

ANALYSIS OF THE AIR DRIED STALK.

Moisture	13.44
Organic matter	72.42
Sand (SiO_2)	.40
Carbonic acid (CO_2)	3.64
Sulphuric acid (SO_3)	.55
Phosphoric acid (P_2O_5)	.59
Oxide of iron (Fe_2O_3)	.34
" " magnesia (MgO)	.52
Chlorine	.65
Lime (CaO)	4.85
Potash (K_2O)	2.88
Soda (Na_2O)	.47
	100.25
Ammonia	3.78

In the above analysis the sulphuric acid is combined with the lime to form sulphate of lime (gypsum). The remainder of the lime is combined with the phosphoric acid to form phosphate of lime.

The soda is combined with the chlorine to form sodium chloride (common salt).

INDUCTIONS.

The careful reader will note a very wide difference between these soils.

Those who have considered lime lands as unfit for tobacco will be surprised to find so large a percentage of lime in Cuba land as well as in the tobacco. After so widespread a condemnation of such fertilizers as kainit, which contains a large percentage of salt, he will be impressed by these analyses that our soil very generally will be benefitted by the proper use of it. The station has used kainit and sulphate of potash on tobacco during four years with marked benefit. We have used as much as from 300 to 500 lbs. of kainit to the acre in compost.

The station soil, unusually poor, was selected because of its sterility to test the value of different manures, and while for causes above stated the experiment was a failure in this respect, and also as to quantity, for the same reasons, still, by reason of these manures, it produced the very best tobacco, so far as texture and quality were concerned. It will be further observed to what an extent iron enters into the composition of the plant, thus indicating, that as our soils are largely deficient in lime, iron and salt, the latter, from which clorine is obtained, that fertilizers, such as common lime, copperas, which is sulphate of iron, should be used, and that such salts as kainit and the sulphate of potash, which supplies the needed potash, will furnish also, so far as kainit is concerned, a good source from which the common salt can be supplied. These analyses are given in the hope that the observant and intelligent farmer will use them to much benefit in the production of his crop.

In this connection it may be as well to state that

HOG PEN MANURE

has also been condemned because, it is said, it imparted the unpleasant odor of the skunk to the segar. The past season a hog pen, used as such for over two years, was planted, and a crop sufficiently large, though small, was made to test the truth of this statement. No such odor has been observed. But this fact has been demonstrated, viz.: that the hog pen tobacco grew rapidly and large, and the tobacco made in it was of the best quality, the segar made from it having a rich Havana flavor and in every way satisfactory. The hog pen manure is, to say the least of it, a good manure for tobacco.

OPINIONS.

1st. After four years experience in growing tobacco, and after resweating and betuning tobacco grown on different kinds of soil in various parts of the State from Lake City to De Funiak and fertilized by different methods, and after making segars from these several samples so treated and testing them, I give it as an *opinion* that the tobacco grown in tropical and semi-tropical regions is dependent more upon the climate than the soil for that aroma, as well as that flavor so much admired.

2nd. That the Pensacola Tobacco Fair demonstrated that Florida soil was very generally adapted to the growth of segar tobacco and that as my observation extends as far south as Ft. Myers, that no one section thus far has demonstrated any special advantage over another in producing it as to quality from Pensacola to Ft. Myers.

3d. That the main point to be learned to make Florida tobacco compete successfully in the markets with Havana and make it valuable lies in the proper sweating and betuning it when stripped from the stalk, and putting it on the market as Florida tobacco.

JAS. P. DEPASS,
Director Experiment Station.

WHERE SEED CAN BE HAD.

NOTE.—Seed to plant small areas can be had free upon application to Hon. L. B. Wombwell, Commissioner Agriculture, Tallahassee, Fla. Those applying for seed who receive this bulletin should state in their application that they have or have not received Bulletin 19, because Mr. Wombwell will send this bulletin to those who apply to him for tobacco seed if they do not make this statement.

Bulletin No. 20. **September, 1893.**

FLORIDA

AGRICULTURAL EXPERIMENT STATION

CHEMICAL DEPARTMENT.

SOILS AND FERTILIZERS

BY A. A. PERSONS.

The Bulletins of this station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

H. DREW & BRO., PRS., JACKSONVILLE, FLA. [illegible]

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INTRODUCTION.

Somewhat wide observation of the use of Bulletins of Agricultural Experiment Stations leads me to think that to a great many people most of the Bulletins are useless, because written in technical language, with which the readers are not familiar. In most cases, a few words of explanation would make the subject clear, and, perhaps, the Bulletin would then be of much value to the reader. In the following Bulletin, Prof. Persons has striven to remove a portion of this difficulty, so far as the chemistry of soils and manures is concerned. It is hoped that the explanations herewith given will aid the readers of future Bulletins from this Station, and, perhaps, from other Stations.

O. CLUTE,
Director Florida Expt. Station.

LAKE CITY, FLA., SEPT. 1893.

SOILS AND FERTILIZERS.

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THE GROWTH OF SCIENTIFIC AGRICULTURE.

Agriculture is a *science* as well as an *art*. As a *science* it explains the growth of plants and animals, and the principles upon which the practical operations of farming depend. As an *art* it teaches *how* to cultivate the soil, to make and use fertilizers, to take care of live-stock, and how to equip and manage a farm economically and successfully.

In a word, the *art* of agriculture consists in understanding how and what to do, and the *science* of agriculture offers reasons for what is done.

Like other sciences, agriculture was practiced as an *art* long before the principles upon which it is founded were understood.

As a pursuit, a means of sustenance, farming has ever been first in importance. This is necessarily true from the very nature of things. Man's peculiar environment would require it. His necessities compel him to cultivate the soil. It is a command of Divine origin, that he must earn his bread by the sweat of his brow.

There are very many reasons why agriculture has progressed so slowly as a science; among them may be mentioned, the lack of a knowledge of other sciences which are, themselves, of recent origin, and which are very closely related to scientific agriculture. The Scientific farmer ought to know something of zoölogy, the science of animals, that he may understand how properly to select and care for his stock. He should, at least, have some idea of botany, the science of plants, that he may understand the various modes of growth of the different families of the vegetable kingdom, and thus, be prepared to adapt his mode of cultivation to the peculiar nature of the crop to be grown. He should be something of a mechanic, in order that he may be able to exercise skill and judgment in the selection of his farming implements, his plows and wagons, and all the various forms of carpentry that will be sure to command his attention, sooner or later.

He should not be ignorant of the science of physics, which treats of the general properties of bodies, such as light, heat and electricity, and the causes which modify these properties.

He ought, also, to know something about geology, the science which deals with the structure of the earth, its formation, its rocks and its soils. We will readily see that this is necessary in order to understand the character of soils, and be able to judge of their value by a mere inspection.

Lastly, it is obvious that a scientific farmer must needs have some acquaintance with the science of chemistry. Of all the sciences relating to agriculture, perhaps the most important results and improvements have been derived from chemistry. Chemistry makes known to us the composition of soils, plants, and fertilizers, and enables us to adapt one to the needs of the other.

Among the benefits to be derived from a knowledge of the science of chemistry, may be enumerated:

1. It teaches the composition of soils, fertilizers, plants and the atmosphere.
2. It acquaints us with the variety and quality of the food that different plants require for vigorous growth.
3. It brings to our attention the action of light, heat, and other agencies in producing plant growth.
4. It familiarizes us with the manufacture of fertilizers, and tells us how to utilize various refuse matter in preparing wholesome plant food.
5. It reveals all the conditions essential to fertility.

SOIL.

What we designate as "soil" is the earthy matter in which plants grow. It consists of different proportions of organic matter intermixed with very finely pulverized rock.

The soil with which the farmer is interested, is the thin, upper surface, in which plants grow. Owing to the fact that vegetable matter is constantly undergoing decomposition in the soil, under the oxidizing influence of the air, the upper layer of the soil, has imparted to it a darker color than the layer immediately underlying it. This has caused them to be classified as *soil* and *sub-soil*. The *soil* is usually more fertile than the *sub-soil*, owing to the presence of this decaying vegetable matter, and probably on account of the carbonaceous matter extracted from the air by the growing plant.

This black vegetable mold we are accustomed to call *humus*, and it is known to play a conspicuous part in plant growth. In addition to its fertilizing properties, it aids, mechanically, in maintaining the soil in a friable condition, thus enabling it to be easily penetrable by the air, heat, and moisture—all essential to vegetable life. If a soil be rich in humus, and underlaid by a somewhat compact sub-soil, it is usually fertile. If the sub-soil is of a very porous character, resembling sand or gravel, it is ill adapted to retaining plant food, and, consequently, much of the fertilizer applied to the upper soil will be washed down out of reach of the plant roots and lost. This is especially true of nitrogen.

MECHANICAL CLASSIFICATION OF SOILS.

Owing to the very large per cent. of sand in many soils, and its presence in all, it has been suggested that they be classified according to the amount of sand they contain. Under this classification, we are acquainted with the following divisions:

1. Pure clay, from which no sand can be removed by washing.
2. Strong clay, from which as much as five to twenty per cent. of sand can be separated.
3. Clay loam, when washing will remove from twenty to forty per cent. of sand.
4. Loam, when a soil is found to contain as much as forty to seventy per cent. of sand.
5. Sandy loam, from which seventy to ninety per cent. of sand may be removed by washing.
6. Light sand, containing more than ninety per cent. of sand.

When a soil is found to contain a notably large per cent. of carbonate of lime, it is said to be a *calcareous* or *marly* soil.

When the per cent. of organic matter in the soil is very large, it is usually described as *peat*, or as vegetable mold.

If a considerable quantity of clay is present in the soil, it is said to be "heavy." A large per cent. of sand, instead of clay, would cause the soil to be described as "light."

It is very easy to classify soils in this way, by simply washing out the sand and weighing it, and, afterwards, calculating the per cent. of sand lost in the process of washing.

We hardly deem it necessary to make, at present, a more extended description.

CHEMICAL COMPOSITION OF SOILS.

Though nearly all soils are made up of the same elements, they seldom occur in any two soils in exactly the same proportions. The proportions in which the different elements are present, will vary with the character of the rock from which the soil was originally formed and with the external influences incident to its formation. A disintegrated sand-stone, or lime-stone rock will each produce a soil possessing distinct characteristics. The difference in the quality and value of different soils for agricultural purposes, results largely from the different proportions of certain valuable elements that must be present in sufficient quantities if healthy growth is to be accomplished.

At present, there are known to the chemist about seventy elements. Only fourteen or fifteen of these are known to occur in the average soil, and believed to be essential to animal and plant life. In as much as the farmer is only interested in these fourteen or fifteen elements, we shall mention only these, and, afterwards, refer briefly to their properties.

NON-METALLIC ELEMENTS.

Oxygen (O)*
Hydrogen (H)
Nitrogen (N)
Carbon (C)
Silicon (Si)
Sulphur (S)
Phosphorus (P)
Chlorin (Cl)

METALLIC ELEMENTS.

Potassium (K)
Sodium (Na)
Calcium (Ca)
Magnesium (Mg)
Aluminum (Al)
Iron (Fe)

To the above may be added Manganese (Mn), Iodine (I), and Fluorine (F), which are sometimes present in minute quantities.

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*The letters in parenthesis are the symbols by which the elements are designated for convenience.

BRIEF DESCRIPTION OF THE ELEMENTS IN THE SOIL.

Oxygen is by far the most abundant of all the elements. It forms about one-fifth of the atmosphere, where it exists in a free and uncombined state, as a *gas*. It is the active vital principle of the air we breathe. It constitutes about one-half of the solid crust of the earth, and eight-ninths of all the water. In these latter forms, it exists in a state of chemical combination with other elements. It combines chemically with nearly every known element, and is especially important in building up, and destroying all forms of organic matter. In a free state it is an invisible gas, possessing neither taste nor smell. It is called a supporter of combustion, because wood, and other burning substances, when plunged into it, will burn with increased brilliancy.

Combustion, such as is constantly taking place in our stoves, and fire-places, is nothing more than the result of the chemical union between the oxygen of the air and the carbon and hydrogen of the fuel.

Hydrogen, is another very abundant element. This is the element, which when chemically combined with oxygen, forms water. It constitutes about one-ninth, by weight, of all water, and enters into the composition of all plants and animals. It is the lightest substance known. Like oxygen, it is an invisible gas, without color, taste, or smell, but, unlike oxygen, instead of being a supporter of combustion, it will, itself, burn when brought into contact with a flame. It is seldom, if ever, found in a free, or uncombined state.

Nitrogen, composes about four-fifths of the atmosphere. In addition to occurring in the atmosphere, it is found also in plants and animals. Its sole mission in the atmosphere appears to be to dilute the oxygen, and thus prevent its too violent action. Animals cannot exist when left to breathe nitrogen alone, and yet it is not poisonous. Unlike oxygen and hydrogen, this gas will neither burn, nor will it support combustion. A burning splinter immersed in a jar of nitrogen will be immediately extinguished. Nitrogen, when chemically combined with hydrogen, forms a gas known as ammonia. This ammonia is a very interesting compound to the farmer, because it constitutes a very important source of nitrogen as a plant-food.

Carbon, is an element that exists in three distinct forms. Charcoal, coke, and lampblack are all varieties of the first form ; graphite, or plumbago, commonly called black-lead (and used for making lead pencils), is the second variety, and the diamond, which is pure crystalized carbon, is the third form. When wood is burned in a covered heap, the greater portion of the residue is carbon. This element enters largely into the composition of all woody substances, and when it burns, it unites with the oxygen of the air to form a gas known as carbon-dioxide, commonly called "*carbonic acid.*"

Silicon occurs abundantly, in combination with oxygen, and in this form is known as silica (sand). As such, it constitutes a large portion of our rocks and soils. It forms about one-fourth of the solid part of the earth. It is seen, in its purest form, in quartz crystals. The sand used by glass blowers is nearly pure quartz. Some chemists doubt whether silicon is a necessary constituent of plants, but all agree that it is found in the stems of grass, wheat and corn, and in various varieties of vegetation.

Sulphur. We are all quite familiar with this substance in the form of "flowers of sulphur," found in every drughouse, or as brimstone, which is only sulphur molded into sticks. Sulphur possesses a well known yellow color, and burns with a pale-blue flame, and very suffocating odor. In combination with oxygen and hydrogen, this element forms sulphuric acid, or "oil of vitriol," one of the strongest of the acids. Sulphuric acid is very extensively used in the manufacture of fertilizers.

Phosphorus. To the farmer, this is one of the most important of the elements. It composes a large percentage of the bones of all animals, and is found in the soil, as well as in plants. If a piece of bone be burnt until the ash is perfectly white, there will be left a larger proportion of ash than would be obtained by burning almost any other substance. About two-thirds of a well dried bone is composed of ash. This ash is very different from all other ash, with which we are familiar, in that, it is almost wholly composed of calcium, oxygen, and phosphorus.

In a chemically pure state, phosphorus is a soft, yellowish solid that emits a white smoke when exposed to the air, and takes fire very easily. It has such a strong affinity for the oxygen of the air, that it is necessary to keep it under the surface of water. This substance is very largely used in the arts, but to the farmer it is chiefly valuable as a constituent of phosphoric acid to which we shall have occasion to refer more extensively hereafter.

Chlorin. This element is never found in a free state, but always in combination with other elements. Its principle compounds are with hydrogen when it forms *hydrochloric* or *muriatic* acid, and with sodium, when it forms common salt. Chlorin occurs in the ash of plants as well as in the soil. In the form of common salt it is an abundant constituent of seawater. It is a poisonous gas, very irritating to the throat and lungs.

All of the elements above referred to as occurring in the soil, are designated by the chemists as "non-metallic elements," sometimes called "*non-metals.*"

The six remaining ones to be described are known as "metallic elements,". or "metals."

Of these, the first to engage our attention is potassium. This is a soft metallic substance, lighter than water, and possessing a very strong affinity for oxygen. So strong is its attraction for this element, that it must be kept under the surface of naphtha, a liquid which contains no oxygen. The pure metal is very hard to obtain, and was unknown, prior to the early years of the present century. In combination with oxygen and hydrogen, this metal forms caustic potash. It is very valuable as a constituent of soft soap, and is utilized in various industrial operations. To the agriculturist it is indispensable in growing successfully all of his various crops. It is potassium in some form of combination that supplies his crops with all the potash they demand. We will speak of potash more at length later on.

Sodium is a soft white metal very similar in appearance and properties to potassium. Common salt is sodium combined with chlorin. Sodium occurs combined with nitrogen to form salt-petre, a very valuable fertilizer. Caustic soda is a compound of this element with oxygen and hydrogen, and possesses properties similar to caustic potash. Caustic soda is used extensively in making *hard* soap, and for other purposes.

Calcium is a metal very difficult to separate from its compounds. With oxygen, it forms common unslaked lime. Marble, limestone, and chalk are all combinations of calcium with other elements.

Magnesium and aluminum, are both hard, white metals, the former is a constituent of magnesian limestone, sometimes called dolomite, while the latter is a constituent of all clay and slate rocks. Magnesium is a very light, brittle metal, and burns in the air with a brilliant flame. The light is so intensely brilliant that it is largely used in taking photographs at night in dark caves.

Aluminum possesses splendid properties, such as lightness and durability, that adapt it to varied and extensive use in the arts, but owing to the fact that no method has yet been discovered by which it can be cheaply separated from its compounds, it has not yet come into such general use as its merits would justify. Improvements are constantly being made in this direction, and, ere long, we may expect to see aluminum in very general use.

Iron, is a very common metal with which every body is familiar. It is too well known to need description.

The yellow substance so often taken for gold, is sulphide of Iron, or "fool's gold." The ores of *iron*, such as hematite and limonite, occur in abundance, and are used in immense quantities in the manufacture of this useful metal. Iron is found in all soils, and constitutes the coloring matter of clays. It exists also in a great variety of minerals.

All the elements enumerated and briefly described above, are of interest to the farmer only because they are very sure to occur in every productive soil. All soils will probably contain each of these elements, but no two soils will be apt to contain them in exactly the same proportions. Experience has demonstrated, however, that only three of them, namely, phosphorus, potassium, and nitrogen, are likely to become deficient in the soil under a continuous system of cropping. Sometimes we find it necessary to use other substances, such as gypsum, in order to render our lands thoroughly productive, but such are never taken into account in estimating the values of commercial fertilizers.

Such substances as gypsum (land-plaster) and lime are only added to soils that are sour and contain large quantities of organic matter. Such lands are very apt to contain elements of plant-food, such as nitrogen, in an unavailable form. The application of lime in moderate quantities, to such a soil, serves to correct the acidity of the soil, decompose the organic matter (humus) and place the nitrogen in a condition where it can be taken up by the plant.

THE OBJECT OF MANURES.

In order that every plant may be enabled to grow to the best advantage, it should have, in addition to light, heat and water, a deep and fertile soil. The laws that regulate the supply of sunshine and rain are beyond our control; but all the other conditions so essential to a fertile soil are entirely within our keeping, and should be guarded with vigilance. Appreciating this fact, it should be the object of the farmer to prepare his soil in the very best manner, to select lands best adapted to the crops to be grown, and to fertilize constantly (but not excessively) so that his farm, instead of decreasing, will increase in value the longer it is used. We will say, then, that the *object of manure is to render our lands fertile and produce good crops.*

WHAT IS MANURE?

Ordinarily this query might be answered by saying that *manure is any material which when added to a soil increases its fertility*, or, in common language, it may simply imply the *droppings* of domestic animals, these droppings, all thoughtful farmers will be careful to save and use for agricultural purposes. It is easy for us to understand why this animal excrement is of so much practical importance to the farmer. It is simply because it contains the elements of plant-food—phosphoric acid, potash, and nitrogen—so essential to vegetation, in a convenient form to be used in plant-growth. When we burn a plant, the material left behind in the form of ash will contain the elements that the plant derived from the soil during its period of growth. The very same action ensues when the plant is more slowly oxidized (burnt) in the body of the animal. The animal also oxidizes that portion of the plant-food, such as carbon, which is obtained from the air.

The animal excrement, then, will be composed of a large proportion of what may be termed the "ash elements" of plants, together with nitrogen, in organic compounds, which naturally decomposes, enabling it to form ammonia, and there is also present a considerable quantity of woody-fibre and other indigestible material.

It is obvious, therefore, that the droppings of animals are composed of all the elements of plant-food that were derived by the plant, from the soil, during growth, and also the carbonaceous matter originally obtained from the atmosphere, this matter subserving to decompose other material, and also assisting in retaining other food that plants must procure from the air.

VALUE OF HOME-MADE MANURE.

Perhaps one of the chief sources of profit on a well kept farm is the manure obtained from stock. No farmer is desirous of farming economically who neglects this very important matter. Unless properly cared for, manure is sure rapidly to lose much of its value.

All manure does not possess the same agricultural value, neither does the excrement from *one* animal possess the same value at different times. The manure from a well fed animal is much more valuable than that from a poorly fed one. The droppings of a half starved animal possess little value as a fertilizer. It is hardly profitable to use, but when the animal has been well fed, on a rich diet like cotton-seed meal or wheat bran, it has been proven that the plant food locked up in the animal manure is more valuable from a money standpoint than was the food itself when purchased in the market. When fed to stock, cotton-seed meal is known to produce a manure of excellent quality. These seeds are now used in immense quantities as a source of nitrogen in the manufacture of *commercial* fertilizer, but it would be much better for the farmer who grows his seed to exchange them for an equal weight of hulls and meal. The manufacturer is generally willing to make this agreement, and finds his profit in the oil collected from pressing the seed. Upon the other hand, the oil in the seed has no fertilizing value, and, in this way, the farmer would gain more real plant food by making the exchange. Then by purchasing phosphoric acid and potash, and mixing them with the meal, he will have another complete fertilizer to supplement his store of barn-yard manure.

HOW TO PRESERVE MANURE.

If animal manure be allowed to remain in the lot, or in the field, exposed to the sun and rain, it will very soon depreciate in value. If kept *too* dry, under cover, it accumulates a considerable amount of heat, and much of the nitrogen will be driven off in the form of ammonia. To remedy this, in addition to being kept under cover, manure should, from time to time, be sprinkled with water, and every several days with land-plaster (sulphate of lime or gypsum).

It will be very easy for us to understand the chemical change that takes place after a very brief explanation. During the fermenting process in the manure heap, carbon-dioxide gas is given off, and likewise ammonia, simultaneously with the decomposition of the material constituting the heap. These two substances will at once combine to form carbonate of ammonia, which is very volatile. Now, when land-plaster is added, the carbon-dioxide contained in the carbonate of ammonia will unite with the lime, composing the plaster, forming the carbonate of lime; and the sulphuric acid which was previously combined with the lime in the plaster, will be set free, and will at once unite with the ammonia contained in the carbonate to form sulphate of ammonia, which will not volatilize as was the case with the carbonate.

Sprinkling with water, from time to time, serves to prevent the heap from becoming too heated. Where one is engaged in growing grasses to any considerable extent, it will be found more economical to spread the manure on the grass as fast as it is collected. In this way all loss that would result from leakage, on account of the manure remaining exposed in the lot, will be saved by being washed directly to the roots of the growing grass to be appropriated as plant food.

Urine from domestic animals should be most carefully preserved, because it contains valuable elements of plant-food in a readily available form. It possesses equal value with the solid excrement as a manure. In order that it may be preserved as far as possible a sufficient quantity of straw should be kept spread upon the floor of the stall in which the animal is kept. It will also be well to sprinkle fresh land-plaster over the straw to retain the easily volatile ammonia that would otherwise be sure to escape during fermentation. Every day or two, this litter should be transferred to the manure heap to undergo decomposition. The stall should be kept in a clean condition, all the scrapings being added to the heap and treated as previously directed.

Too much stress cannot be laid upon the necessity of preserving home-made manure, and a prominent object will have been gained if this bulletin shall be the means of inducing our farmers to give this matter serious consideration, and cause them to resolve, from this time on. not to cast aside valuable fertilizers that could be profitably employed.

COMMERCIAL FERTILIZERS.

Not many of our farmers, even though they practice a most rigid system of economy, will be enabled to save from the various domestic sources a sufficient quantity of fertilizers to supply their various agricultural needs.

Here then comes the necessity for buying *commercial fertilizers*, and for knowing how and what to buy.

As before stated, the design of commercial fertilizers is to supply in an available form the three elements of plant-food, viz.: phosphoric acid, potash and nitrogen, that are likely to become deficient under a continuous system of cultivation. A commercial fertilizer may contain one or more of these substances. A *complete* fertilizer is one known to contain all three of them in proper proportions. A soil may or may not, need to be supplied with a complete fertilizer. Much will depend upon the system of cropping that has been practiced. One crop will require more of one particular element to grow successfully, than another crop would likely employ. Such an element, if not re-supplied to the soil in the form of a fertilizer, will soon become exhausted in the soil. In this way the soil would soon be rendered unproductive and incapable of yielding good crops. This is a *fact*—it is *reason—it is plain common sense*—and yet we encounter men every day who claim to be intelligent, who are always ready to disparage the use of commercial fertilizers, and advise all to leave them severely alone.

Doubtless many of our so-called "commercial fertilizers" *are* frauds, put upon the market by a class of dealers whose only aim is to swell their own purses by practicing their nefarious traffic. It is the province of the chemist to find these men out, and expose their rascality. Much has already been accomplished along this line, and much remains to be done.

Luckily, and naturally, laws have been enacted by the legislatures of the several States that provide a punishment for those who choose to make their living in this way, and these laws were passed solely to serve as a means of protection to the farmer. If a manufacturer or a dealer is detected in an attempt to defraud, by palming off on the purchaser worthless goods, the strong arm of the law comes at once to the buyer's rescue and metes out a just punishment to the defrauder.

Our laws do not prescribe any standard for the composition of a commercial fertilizer—the manufacturer is left free to make his own standard—but the law does prescribe that the fertilizer he offers for sale shall be up to the standard claimed by the manufacturer. The license granted the manufacturer to sell his article, does not certify to the value of the fertilizer, but simply states that the manufacturer or dealer offers for sale a fertilizer that is declared to contain a certain per cent. of phosphoric acid, potash and nitrogen, and that a sample of the fertilizer has been deposited with the Commissioner of Agriculture to be analyzed by the chemist, whom the State employs for that purpose. The *claimed* and *found* analyses are then published in Bulletin form, in parallel columns, and the purchaser is enabled to see at a glance the exact composition of the fertilizer he proposes to buy.

Frequent letters have been received at this office during the past year asking for information in regard to buying and using commercial fertilizers. Now that the season for purchasing is fast approaching, it may be well to devote the remaining pages of this Bulletin to answering these numerous inquiries, in order that those who contemplate buying may know how to do so intelligently; understand how to buy, what to buy, and how much to buy.

Before we can understand *how* to buy, we must first know just what we desire—what we are buying. It will, therefore, be well for us to consider, somewhat briefly, the three fertilizing elements necessary to be supplied from time to time, to maintain the fertility of all soils, viz.: phosphoric acid, potash and nitrogen. It will be well also, to note the forms in which these several substances exist, their mode of occurrence, their composition and the sources whence they may be best obtained for utilization in the manufacture of fertilizers.

PHOSPHORIC ACID.

When the term "phosphoric acid" is used in connection with the chemical analysis of a fertilizer, it signifies a compound which is really not phosphoric acid, but simply one of phosphorus and oxygen. True phosphoric acid could not well exist as such in a fertilizer. So that in an analysis, the numbers under the heading "phosphoric acid" *state the amount of phosphoric oxide* (P_2O_5) above mentioned, *that is equivalent to the phosphoric acid in the form of phosphate of calcium* (bone phosphate) *actually existing in the fertilizer.* True phosphoric acid is a compound of three elements, viz.: phosphorus, hydrogen and oxygen, but in the form in which we are accustomed to use the term the hydrogen of the acid has been displaced by some other substance, usually *lime* (calcium) and a salt formed which is known to the chemist as tri-calcic phosphate. It is very customary to speak of this compound as "insoluble phosphoric acid," because only a very small portion of it is readily soluble in water.

"Insoluble phosphoric acid," then, is the form in which phosphorus exists in most soils, in bones, and likewise in most rocks which are employed in the manufacture of commercial fertilizers (super-phosphates, etc). Bones being of an organic nature, are more rapidly disintegrated in the soil than the rock from which the so-called rock-phosphate is derived, and hence, in a crude state, when both are finely ground and mixed with the soil, the ground bone will be rendered much more quickly available as a plant-food. The rapidity with which either is converted into an available form will vary greatly with the character of the soil, its condition after cultivating different varieties of crops, its composition, etc.

As insoluble rock-phosphate, phosphoric acid occurs in immense quantities in Florida, South Carolina, and in considerable quantities also in Alabama, California and North Carolina. In Florida and South Carolina the supply is practically inexhaustible. In view of the fact that the demand for commercial fertilizers is increasing all the while, it is not improbable that the State of Florida will yet become immensely wealthy from the development of this single industry. The quality of the phosphate rock, mined in this State, is not inferior to that mined elsewhere in the United States, and the attention of the whole country has been directed to the phosphate deposits of Florida.

As the farmers become more and more appreciative of the benefits to be derived from the use of fertilizers we may expect to see the demand for Florida phosphate increase, until after a while the phosphate industry will become to Florida what the iron industry is to Alabama.

Phosphoric acid is more universally deficient in soils than any other substance necessary to the growth of plants, hence the great importance of phosphatic manures.

In a chemical analysis, this acid is usually reported under two divisions, namely, "available" and "insoluble" phosphoric acid. They have very different commercial values, the "available" being usually estimated at .07½ cents, and the "insoluble" at .02 cents per pound—the latter is the least valuable of all forms of phosphate.

The way in which the crude phosphate rock is usually rendered soluble and readily available, is by treating it with sulphuric acid, thus converting it into what is known as super-phosphate or acid-phosphate. This may be accomplished by mixing the ground rock with half its weight of sulphuric acid (previously mixed with two or three times its weight of water). The water should be first placed in the vessel that is to contain the mixture of acid and water, and the acid should be added very slowly (because a great evolution of heat and steam will be sure to occur) and should be stirred constantly. Next pour the acid upon the ground rock, thoroughly mix, and allow the mixture to stand about an hour. At the expiration of this time, the re-action will have been complete, and then the mixture will soon dry and be free from moisture. As a means of getting rid of any excess of acid, rich earth, saw dust or ashes are mixed with the mass, these will serve to neutralize the excess of acid.

Doubtless it will be better for the average farmer to *buy* his super-phosphate directly from the manufacturer or dealer, rather than encounter the risk of making for himself an article of inferior quality.

POTASH.

When the word "potash" is used in reporting a fertilizer analysis, it always signifies the compound of potassium and oxygen, known as potassium oxide (K_2O) or potash. It really never occurs in this form in a fertilizer, but chemists prefer to report it in this way merely as a convenient standard for reference. *Potash* generally occurs in fertilizers in such forms as the chloride (muriate), sulphate or carbonate of potash, and in an analysis, under the column marked "potash," we have only to remember that the figures used simply *denote the per cent. of actual potash* (K_2O) *that is equivalent to the sulphate, chloride or carbonate of potash that is contained in the fertilizer reported.*

Potash occurs widely distributed in the soil in various complex mineral compounds. It also constitutes a very large proportion of the ashes of plants. It is the chief fertilizing ingredient derived from wood ashes, when they are spread upon the soil.

Potash is also found in other forms of combination—sometimes mixed with common salt—and is dug in immense quantities from mines far below the surface of the earth. The largest and most important potash salt mines are located near Stassfurt, in Germany. From these immense mines these salts are imported in the form of sulphate of potash, muriate (chloride) of potash, kainit, etc.

Commencing near the Stassfurt mines only a few years back, the use of potash salts as a fertilizer, has already become universal in Germany—has extended largely over the European Continent, and, finally, has rendered much of the barren soil of our own country productive, and even the coffee fields of Brazil have been made to feel the beneficial effects of its application.

Formerly the amount used per annum, was only a few hundred tons, now the annual consumption reaches many thousand tons.

It is more than possible that as our knowledge in regard to using fertilizers increases, it will be found that we were once not fully appreciative of the benefits to be derived from a liberal application of potash fertilizers to our soils.

Mr. G. H. Whitcher, Director of the New Hampshire Experiment Station, has written a learned article along this line, in which he points out that the ratio of phosphoric acid to potash, as found in the ashes of plants is as 1 is to 3, whereas in compounding the fertilizers used in producing that plant, the ratio adopted was just the reverse, viz.: three parts of phosphoric acid to one of potash. This gentleman inaugurated a series of experiments to test the correctness of his idea, and the results obtained were highly satisfactory. So strong is Prof. Whitcher's belief that the average commercial fertilizer contains a deficiency of potash, that he was constrained to close his admirable article with the following vigorous language: "I wish to say that I am thoroughly convinced that our fertilizer manufacturers must give us in New Hampshire more than four per cent. of potash, and from other New England States, I am receiving letters which convince me that New England, as a whole, would be benefitted by ten per cent. of potash in the fertilizers used, and were I to buy prepared fertilizers to-day for our general crops, I would get some of the so-called 'special potato fertilizers,' since they have more potash than any others in the market."

NITROGEN.

In its natural state, nitrogen is a gas. As such, it could not well exist in a fertilizer. Whenever reference is made to nitrogen, therefore, in a fertilizer, the intention is not to state that it really exists in that fertilizer as simple nitrogen. As it occurs in fertilizers, it is always combined with other elements, and may be present in several different forms of combination, to-wit: 1st, in the form of organic matter, either animal or vegetable; as dried blood, flesh, tankage, tobacco stems and cotton seed meal; 2d, as nitrates; as nitrate of soda, nitrate of potash, etc.; 3d, in the form of ammonia compounds; as sulphate of ammonia.

According to the official method for analyzing fertilizers, the chemist does not attempt to ascertain and state in precisely what form the nitrogen is present in a fertilizer. Accordingly, when an analysis is reported, in the column under the heading "nitrogen," the figures used are simply intended to state the amount of nitrogen present, without regard to the form in which it exists, or, in other words, these figures *tell us how much nitrogen the fertilizer would contain if it were all present in the form of pure nitrogen gas.*

SOURCES OF NITROGEN AS A FERTILIZER.

Nitrogen is one of the most expensive elements of plant-food. It is, at the same time, one of the most important, and is also the most difficult to keep in the soil to supply the needs of growing crops. When it is present in the form of nitrate of soda or nitrate of potash it is dissolved and carried out of the reach of the plant roots very rapidly by water.

If present in the form of ammonia, as it occurs in manure heaps, unless precautions are taken, a very large per cent. of it will escape into the air. And when it is applied to the soil in the form of ammonia, it will soon be changed into the form of nitrate, and as a nitrate, if not very soon appropriated by the growing plant, it will be dissolved and carried off by the soil water. So that in whatever form nitrogen is employed as a fertilizer it is exceedingly difficult to manage so as not to waste a considerable portion of it. It is always necessary, therefore, on account of these facts, and also on account of its high cost, to exercise the utmost care whenever nitrogen is employed as a fertilizer.

The largest natural source of this element, at present, is from the large nitre beds that occur in Chili. In these beds it exists in the form of nitrate of soda, sometimes called Chilian salt-petre. This salt has a very extended use for fertilizing purposes, both as a top dressing for crops and for mixing in commercial fertilizers.

Nitrogen is also found native in the form of nitrate of potash, in the soil of limestone caverns and also under houses.

Artificial nitre-beds may be easily prepared by mixing the scrapings from the poultry yard with various waste material occurring about the farm, and afterwards mixing with rich earth, and sprinkling now and then with water. The heap should be covered with some porous material to absorb any nitrogen that might escape into the air. Although nitrogen occurs in great abundance in a free state in the atmosphere, there are only a very few plants that are known to employ the atmospheric nitrogen as a food while growing.

There is a division of plants, known as the *legumes*, including the pea, bean and clover families, that is capable of employing this nitrogen during growth. *Just how* they are able to do so, is still quite imperfectly understood. It has been asserted by some that these plants took in this nitrogen directly from the air, through very minute breathing pores that occur on the under surface of their leaves, but this theory now appears to have very few adherents.

It seems more probable that the atmospheric nitrogen is secured through the agency of minute microscopic *fungii* that infest the roots of these leguminous plants. Upon these plants there has been observed certain tubercles or swellings, in which this fungus growth subsists. This fungus is itself a little plant, and its manner of growth is very similar to that of the *yeast* plant, which is known to be the agency which produces alcoholic fermentation in sugar solutions.

We may, perhaps, be warranted in asserting that some plants at least, are capable of using during growth the nitrogen of the air, and that their ability to do so is due to a certain ferment, which, in the presence of warmth, moisture and darkness, feeds upon the free atmospheric nitrogen, and, as a result, nitrates are formed, and in this form the growing plants utilize the nitrogen which this ferment has thus rendered available. We are now prepared to understand why it is that certain plants, like cow-peas and clover, are highly beneficial in a system of crop rotation. Such plants gather from the atmosphere, and supply to the soil the most expensive element of plant food that would otherwise have to be supplied in the form of a purchased fertilizer.

As before stated, whenever it is found necessary to buy artificial fertilizers, perhaps the most economical source of nitrogen to the Southern farmer is the meal obtained from cotton seed cake, after all the oil has been expressed. In nearly every instance, this will be found the best and cheapest source, where the fertilizer is to be prepared at home.

Much more might be said upon the subject of nitrogen and its use as a fertilizer, but it is to be hoped that what *has* been stated will be sufficient to afford at least a fair understanding of this very essential element, as regards its adaptation to fertilizing purposes.

NITROGEN EQUIVALENT TO AMMONIA.

It is very common among manufacturers to express the per cent. of nitrogen present in a fertilizer as "equivalent to ammonia." They prefer to express it in this way probably for the reason that, if the nitrogen is expressed as ammonia, larger figures are necessary to describe the analysis, and, if the farmer knows no better, the larger figures used will serve to impress him with the belief that a larger per cent. of nitrogen is present than really is. This method is in perfect accord with legal requirements, but it would be well for the farmer to remember that nitrogen and ammonia *are two different substances*, and that one pound of ammonia is equivalent to only about *eight-tenths* of a pound of nitrogen. Let us understand this:—Ammonia is a substance composed of nitrogen and hydrogen combined; therefore a pound of nitrogen will form over a pound of ammonia, for the reason that the ammonia formed from a pound of nitrogen will contain, in addition to that nitrogen, a certain amount of hydrogen. The chemical relations existing between nitrogen and hydrogen are such that fourteen pounds of nitrogen will unite with exactly three pounds of hydrogen, to form *seventeen* pounds of ammonia one pound of nitrogen will therefore make 1.215 pounds of ammonia.

Then, in conclusion, it may be well to remember that if the nitrogen in a fertilizer is reported in the analysis as "equivalent to ammonia," it does not mean to imply that the stated per cent. of ammonia actually was present—indeed, there may have been no ammonia at all in the fertilizer, what the figures used do intend to state is *how much ammonia there would be if all the nitrogen were present in that form.*

EXPLANATION OF A CHEMICAL ANALYSIS.

There are doubtless many farmers in our State who do not understand the meaning of the figures used to express the result of a chemical analysis of a fertilizer. To all such we will simply say the figures used merely indicate parts per hundred, or, in other words, they tell us how many pounds of each ingredient is present in every hundred pounds of fertilizer. Thus, suppose our analysis reads:

Phosphoric Acid	10.20	per cent.
Potash	3.15	"
Nitrogen	3.50	"

This would simply mean that in every one hundred pounds of the fertilizer mixture there is present, in an equivalent form, a little more than ten pounds of phosphoric acid, three pounds of potash, and exactly three-and-a-half pounds of nitrogen.

By remembering this explanation it will be a very easy matter to know, when we purchase fertilizers, just exactly how much of each valuable ingredient we are securing.

HOW TO ESTIMATE THE MARKET VALUE OF A FERTILIZER.

To find the market value of a ton of fertilizer requires only a very simple calculation. The prices paid, per pound, for the several ingredients are the ones uniformly paid in most States, and are based on the prices these goods will bring when placed on the market.

In the calculations below the price of the available phosphoric acid is placed at 7½ cents, insoluble phosphoric acid at 2 cents, potash at 5 cents, and nitrogen at 19½ cents per pound. Then let us ascertain the commercial value of a ton of a fertilizer of the following composition:

Available Phos. Acid	8.20%x20=	164.00 lbs.,	in ton	@ 7½ cts.=	$12.30
Insoluble Phos. Acid	2.00%x20=	40.00 lbs.,	"	@ 2 cts.=	.80
Potash	3.15%x20=	63.00 lbs.,	"	@ 5 cts.=	3.15
Nitrogen	3.50%x20=	70.00 lbs.,	"	@ 19½ cts.=	13.65
Market value, per ton, equals					$29.90

In the above calculation the following method was pursued:

The number of pounds of available phosphoric acid contained in each hundred pounds of the fertilizer mixture was multiplied by twenty in order to get the number of pounds of the "available" that would occur in a ton (2,000 pounds) of the fertilizer; then the number of pounds of this "available" acid occurring in a ton was multiplied by the market value per pound (7½ cents). This gave an amount representing the value of the "available" acid in one ton of the fertilizer.

The same course was pursued in obtaining the commercial value of each of the other ingredients, viz: insoluble phosphoric acid, potash and nitrogen.

Then, by adding the market values of the several ingredients, the commercial value of a ton of the fertilizer was estimated.

CONCLUSION.

In conclusion it is only necessary to express the wish that the facts which we have endeavoured to place before our farmers, in an intelligible form, may not only be interesting reading, but may serve to aid them in buying for their farms the fertilizers which will surely prove profitable to the agricultural interests of Florida.

It is our earnest hope that in these pages we have succeeded in placing in plain and simple language some of the facts bearing upon plants and what is necessary to make them grow. All the theories that we have advocated herein are the definite results of modern scientific research, all have been thoroughly demonstrated in practice a thousand times.

It is our hope that the information in this bulletin will enable our readers better to understand the terms used, from time to time, in our station publications, and thus render those publications of more practical value. If this is done, our object in publishing a bulletin of this character will have been accomplished.

Bulletin No. 21. October, 1893.

FLORIDA

Agricultural Experiment Station

BIOLOGICAL DEPARTMENT.

The Tomato and Somo of Its Diseases.

BY P. H. ROLFS.

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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INTRODUCTION.

Growing tomatoes is one of the important and increasing industries of Florida. To know the best varieties, the best methods of cultivation, and the best ways of fighting diseases and insect pests means annually many dollars to the individual growers, and a large sum in the aggregate to the people of the State.

In this bulletin, No. 21, Prof. Rolfs, Biologist of the Experiment Station, states some valuable points in regard to selecting seed, growing the young plants, and their after cultivation, founded on his observation and experience. He has for some years made a study of the insects injurious to the tomato and of the diseases which affect it. His work last summer led him to the very significant discovery that the disease in Florida known as "tomato blight" is a fungus, the mycelia of which enter the tomato plant from the soil and grow within the tissues of the plant. The discovery has already led to methods of battling with the blight that have helped much in holding it in check. Prof. Rolfs will continue the investigation, and it is hoped that the work of the coming year will reach results that will enable all growers to save themselves from further loss by this disease.

O. Clute,
Director.

Lake City, Fla., October, 1893.

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The Tomato, and Some of Its Diseases.

History.

The tomato is a native of tropical America, where it was cultivated by the natives before Columbus sailed across the Atlantic. The invading European carried it back with him, and cultivated it as a curiosity. While it was cultivated as an ornamental plant it was considered poisonous, and the name love apple was given to it. Many of the older people now living remember when it was known by this name, and was considered anything but palatable.

It was found by Dr. E. L. Sturtevant that (Md. 2d Ann. Rep.) they were eaten by the French at New Orleans as early as 1812, and grown as vegetables in New York in 1825, while in New England they were treated as curiosities in 1832. The value of the crop in the United States now is several millions of dollars annually. New Jersey, Maryland and Virginia each raise very large crops; that of Virginia alone is estimated to be over a million dollars annually. North Carolina and Georgia make it an important industry. In Florida it is rapidly approaching the million-dollar line. The last crop was considerably cut back by diseases from what it otherwise would have been. There are few crops grown that will bring a cash return in so short a time.

Botany.

There are two species of the genus *Lycopersicum* now in cultivation.

1. *Lycopersicum pimpinellifolium*, Dum., is known as grape tomato, currant tomato, and sometimes other names are used. This species grows its fruit in a two-ranked raceme. The individual berries are usually smaller than a scuppernong grape. Its

color is bright red and the fruit is more attractive than pleasant. It is sometimes grown for pickles, but oftener as an ornament.

2. *Lycopersicum esculentum*, Dum., is the species that contains the varieties which include our commercial kinds.

The following are recognized as varieties by botanists:

A. *Var. cerasiforme*, the cherry-shaped tomatoes, may be at first sight taken as a very large form of the currant tomato (*L. pimpinellifolium*), but there are fewer fruits in a cluster and the foliage is coarser. The color of the fruit may be either red or yellow, the leaves are lighter colored and usually are smaller than in the common market kinds, but the general shape is the same. *Green gage*, *peach* and *white apple* belong to this *variety*.

B. *Var. pyriforme* contains those that are more or less pear-shaped or oblong. There are two groups: the pear-shaped and the oblong. King Humbert and Criterion are examples.

C. *Var. vulgare.* To this variety belong the different forms of our cultivated kinds. 1st. Angular form were the first cultivated for market; they are not so popular now; they are flat and very irregular, making too much waste in preparing for table. 2nd. Apple-shaped form is the one usually cultivated for market. There are purple, red, yellow and white members in this form, the red predominating.

D. *Var. grandifolium*, or large-leafed tomatoes. *Mikado*, *Puritan* and *Shah* are members of this variety. They are much prized for home market, but are too large to make a good shipping tomato. The main difference between these and members of *var. vulgare* is that the leaves of this variety are much larger, the leaflets about two pair, and the leaves of the young plants entire. They are mostly purple, but red and yellow ones have been grown.

E. *Var. validum* contains the upright forms. French *upright* or *tree* tomato is a representative; the fruit is red.

Briefly expressed, we have:

Fruit small in many berried racemes, leaves small, stems slender. *Lycopersicum pimpinellifolium.*

Fruit larger, few in a cluster; leaves large, stems stocky. *Lycopersicum esculentum.*

Fruit not large, globular, two-celled, red or yellow; foliage light colored. *Var. cerasiforme.*

Fruit larger, pear-shaped or oblong; pendant, red or yellow; foliage dark green, coarse. *Var. pyriforme.*

1st. Pear-shaped form. 2nd. Oblong form.

Fruit large, angular or apple-shaped, purple, red, striped, yellow or white; foliage abundant; leaves of several leaflets, stems-stocky. *Var. vulgare.*

1st. Augular form. 2nd. Apple-shaped form.

Fruit large, purple, red or yellow; leaves very large, of young plants entire; leaflets few, very large. *Var. grandifolium.*

Fruit medium, branches standing upright, tree-like. *Var. validum.*

cf. Cornell, B. 32; Mich. B. 48; Md. 2d Ann. Rep.

Scale of Ideal Tomato.

Since the cultivation of the tomato began there has been a constant increase in the size of the fruit and in the weight of the herbage. The increase in size of fruit has probably gone beyond the profitable point in some kinds, as those bearing the largest fruits are not the most prolific bearers, nor do they give the largest crop. Then, again, the size of the fruit is increased at the expense of the constitution of the plant, or the power to resist diseases.

The following is the scale of an ideal tomato for Florida:

Vigor of plant	20
Productiveness	15
Shipping qualities	15
Earliness	10
Color	10
Shape	10
Size	10
Flavor	5
Cooking qualities	5

By referring to the scale of the ideal tomato for Florida, it will be seen that great stress is laid on the vigor of the plant. This point should be carefully guarded, because diseases of the plants have caused more loss than all other causes combined. It is easier to cultivate a field of healthy, vigorous plants than a field of sickly ones.

Productiveness is everywhere an important quality, and one that shows considerable variation in different kinds, and often in different strains of the same kind.

Some tomatoes are good in every other respect, but do not ship well. They may for some unknown cause rot earlier than other kinds when they are subject to exactly the same conditions; then they may not ship well because of being soft or easily bruised.

In some localities *earliness* is also an important factor; but in localities where there are no winter frosts this point would not scale so much.

Color, shape and size are qualities that are simply matters of convenience and of preference. As the market value of a vegetable depends very much on its appearance. Whatever qualities go to make up its appearance must not be overlooked. The flavor and cooking qualities are not given many points, because these are not affected by different kinds to an extent which injures the market value.

A brief description of some of the kinds that are popular in Florida will be given here. There are some kinds that are quite new and promise to be as good as any in this list, and there are some old ones that are nearly as good as these; but the list is so long that it cannot be given.

Twelve Good Tomatoes.

(1.) *Beauty* has its fruit uniformly smooth and of even size; slightly flatter than *Stone;* the color is pink; good shipper and fair flavor; stands fairly against disease; some fields suffered from macrosporium and from blight; yield good. With some growers it is quite a favorite. On the whole, it is one of our best kinds.

2. *Ignotum* originated at the Michigan Agricultural College, and has been offered by seedmen for a number of years. A vigorous grower, fairly early and quite productive; a good keeper and shipper; deep red and large on well fertilized soil; smooth and of good flavor. It may not be the most resisting against disease.

3. *Long-keeper* is another good one of the purple kind. It

is of medium size, and ripens quite evenly. Its right to this name has been disputed, but whenever the field was free from disease no complaint has been heard.

4. *Mikado* has been much praised. It is a fine tomato for home use; a little too large to make a good shipper. The blight is very severe on this kind.

5. *Red Mikado* is like *Mikado*, except that it is red instead of purple.

6. *Paragon* is of a good size; rather late; the color red; the fruit somewhat inclined to be angular, but generally regular; solid, but less productive than *Volunteer*.

7. *Peach* is given because it is somewhat of a novelty; does not bear much handling; a small pinkish tomato, with more or less of a peach bloom and roughness; palatable, and a decided acquisition to the table-garden; qualities good, but too soft for shipping.

8. *Perfection* is highly praised in seed catalogues, but cannot stand shipping.

9. *Potato-leaf* is so called because of the peculiar foliage. It belongs to the *Mikado* kinds. The color is pink; fruit large, and a good producer, but cannot stand the rough handling of shipping.

10. *Stone* is quite solid on account of the thick cell walls, consequently a good shipper. More spherical than *Beauty*, and often has a scar or other irregularity at the apex. The fruit averaged a little heavier than that of *Beauty*. Probably somewhat more attacked by blight than *Beauty*, but less by macrosporium.

11. *Volunteer* is quite similar to *Paragon*, but more regular and more productive; a good all-round tomato.

12. *Acme* is another good variety. It will class well with *Beauty* and with *Stone*. In some cases it seemed quite certain that the so-called *Acme* tomatoes were really *Stone*.

How to Improve Our Tomatoes.

The present kinds could be much improved by selecting our own seed, always keeping in mind the points desired. Selecting seed from fruit that is not ripe makes the fruit ripen earlier, but at the expense of the vigor of the plant and size of fruit.* Selecting from diseased plants produces a predisposition in the progeny to take the disease. Selecting seed from culls or from fruit in any way defective will tend to reproduce this character. It would not be well to plant several varieties together if one wishes to raise seed. The varieties mix to such an extent that the progeny will not be like either parent, and often it happens that the result of such mixing gives a much inferior fruit. This is due to the tendency that fruits have to revert to the ancient parent; a tendency known in breeding as atavism.

The results of taking the seed for six successive generations from tomatoes not ripe as compared with seed taken from fully ripe tomatoes of the same variety showed that the amount of foliage and stems by weight was less than half as much in the plants from immature seed as from plants from ripe seed. The comparison of the number of fruits showed those from the immature seed more than double that of the same number of plants from mature seed. The average weight of the individual fruit of the immature seed was found to be about an eleventh less than that of the mature fruit. Selecting green tomatoes for seed had a tendency to make the fruit ripen earlier, but with this there was a loss in firmness and in keeping qualities. Both of these are essential elements and must not be looked upon too lightly.

Another important point is that immature seed is much less liable to germinate. Fruit growers frequently complain of particular kinds "running out." From what has been said in regard to breeding, it will be seen that it is quite out of the normal for them to do otherwise. The particular surroundings will cause some point to be fostered at the expense of others. In the above illustration of choosing green fruit for seed, at the end of six generations the plants from the immature seed produced weaker vines, more fruit, smaller fruit, and the fruit matured, on an average, twelve days earlier. The above points seem to be important enough to found a new kind of tomato. This enforces the argument of home-grown seed, and the buying of seed from a careful breeder.

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*E. S. Goff, Wis. Agrl. Exp. Sta. 8th Ann. Rep., p. 152.

HOW TO SELECT FOR SEED.

Every tomato grower should select for seed those tomatoes that have the particular qualities that he desires. The prevailing opinion that some kinds of tomatoes are more resisting to disease than others has a foundation in fact. In selecting the tomatoes they should be taken from healthy, thrifty plants that have borne a good crop of fruit in the proper season. The different tests show that the selecting of first-ripe fruit does not tend to increase the earliness of the progeny. Let it be stated again that the plant in its general looks and form of fruit has more influence over the future crop than the shape, form, etc., of the individual fruit.*

In selecting seed much care should be exercised to get the best; this will always be found the cheapest in the end. A dollar or two should not be taken into consideration when purchasing seed. If one saves his own seed it is of the greatest importance that care should be taken to save the best. The average number of seed to a pound is 151,000. Planting the field 4x4 feet will accommodate 2700 plants; or a pound of first-class seed would plant 56 acres of tomatoes, or an ounce would plant 3½ acres. These figures give us somewhat of an idea how much our seed falls below first-class. If a person saves his own seed it is not a difficult matter to have 90 or 95 per cent. of it germinate. The further advantage is that you know it to be *the* seed. Much of the seed sold is not true to the name, and some that is true to name is from plants that are degenerating. Again, the selecting of your own seed will insure that the kind is more or less acclimated and fortified against the diseases peculiar to our State, such as the blight, dropping of flowers, etc. It will also be noticed from a previous discussion that by constantly choosing seed from immature plants the quality of the fruit and general vitality of the plant is lowered.

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*Md. 2d Rep., p. 40.

TREATMENT BEFORE SETTING OUT.

In parts of the State where there is danger of frosts the plants need not be set out until they are almost large enough to bloom. The seed should be sown in seed-beds where they have plenty of sun and can be protected during a cold spell. Plenty of room should be given so the seedlings will not grow spindly. This precaution is rarely ever carried out. As soon as the plants "cover the ground" in the drill of the seed-bed they should be transplanted to a plant-bed; here the rows should be six inches apart and the plants four or five inches in the row. As soon as they "cover the ground" again, transplant again. Do not simply remove every other plant and leave half not transplanted; the transplanting is what does the good. This may be objected to as making too much work; let us see whether it pays? Prof. L. H. Bailey, of Cornell University, has tested this for several years, and finds that in 1891 the date of the first picking was nineteen days earlier, and, on the whole, the crop was decidedly heavier.

A similar test was made at the Georgia Experiment Station by Prof. Speth. The seed was sown in hot-beds. When the plants became crowded one portion of the hot-bed was thinned until the plants were four inches apart; another portion of the plants was transplanted to the same distance. When the plants became crowded again, the portion transplanted before was again transplanted, and the other thinned out, so as to give them exactly the same distance. In the hot-beds the culture and fertilizer were the same. Both sets of plants were planted out at the same time and treated alike in the field. The ones transplanted twice were earlier by six or eight days, and gave an increased yield of 25 per cent.*

LEGGY, OR DRAWN PLANTS,

as a rule, do not amount to much. When they are planted in the field much valuable time is lost in setting and in waiting for their recovery. If these must be set out it has been found better to make a deep hole, and set in an upright position, or as near upright as possible, and not leave so much top that it cannot stand up well.

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*Ga. Exp. Sta., B. 17.

SETTING OUT.

By the process of transplanting several times the plants are made stocky. This gives an advantage also when it comes to setting out in the field. The fibrous roots, in place of being long and stringy are short, stout and matted together. The condition of the stem is a fair index of what the roots are; if there is a long sickly stem, you are quite sure that there is not a healthy, heavy mat of roots. A heavy bunch of roots carries considerable dirt with it; enough often to support the plant until new roots are formed, and there will be scarcely any shock to the plant from replanting. There are a number of ways for planting. Many use the "peg and bucket" style. Every tomato grower knows exactly what it means to have a lame back. Help for this kind of work is often scarce and many times cannot be had. When a person plants and waters an acre in a day he does enough, if it is done well.

MACHINE FOR TRANSPLANTING.

Several machines have been invented to overcome this "back-breaking" operation. A machine similar to the one figured on the opposite page has been used at Lake City by the tobacco growers. It is, however, equally well adapted for setting out tomatoes, egg-plants, cabbage, sweet potatoes, or any other vegetable. There is a decided advantage in using the machine over the "peg and bucket."

THE OPERATION.

An opening is made, the intended quantity of water dropped, the plant set in this water and the dirt pressed firmly about the plant; all done while the team is walking along. By referring to the picture you will see the tank for carrying water. Just above and forward of this is the driver's seat. By this it will be understood that the picture shows the machine as seen from behind. On each side of the tank is a broad, flat wheel to keep the machine from sinking into the soil. Just below are the seats for two boys. The covers of the wheels and two back stays secure them in their places. The improved machines have an attachment to regulate the movements of the boys' hands in setting, so the plants are placed at perfectly regular intervals. A drag at the side makes a mark to guide the driver while planting the next row. The shoe attachment is shown connected to the machine, while the wheels are shown separately and disconnected behind the machine. The whole contrivance is so simple that any tomato grower can appreciate it. The boys can do their work easily from the first. The amount that one is able to plant in a day depends altogether upon the conditions and the man running the machine.* If the tomatoes be planted 4x4 feet, six or eight acres may be planted in a single day on land in good condition.

Use of Chemical Analysis.

A good chemical analysis of any plant makes an index of what the plant needs from the soil and air. Now, if we have at hand the analysis of our soil, and know what the plant obtains from the air, we can compare these with the analysis of the plant and know with some certainty what should be added to the soil to grow the plants. Often certain elements are present, but are not in the proper combination to be appropriated. and hence may be no more available than as though they were not in the soil at all. The elements usually wanting in our soil are nitrogen, phosphoric acid and potash. Too much of any one element of plant food is not only useless but often a direct detriment.†

AMOUNT OF DIFFERENT ELEMENTS REMOVED FROM SOIL.

Chemical analysis shows that for every pound of tomato (N. J. Exp. Sta., B. 63) removed from the ground .00152 pounds of nitrogen is carried off. Putting the crop of an acre at 200 crates of 60 pounds each, there would be removed from the soil a little more than 18 pounds of nitrogen. This nitrogen had to be in some available form for the plant.

The amount of phosphoric acid in a pound of tomatoes is .000661, a little more than one half as much by weight as nitrogen; or nearly two-thirds of a pound for every thousand pounds

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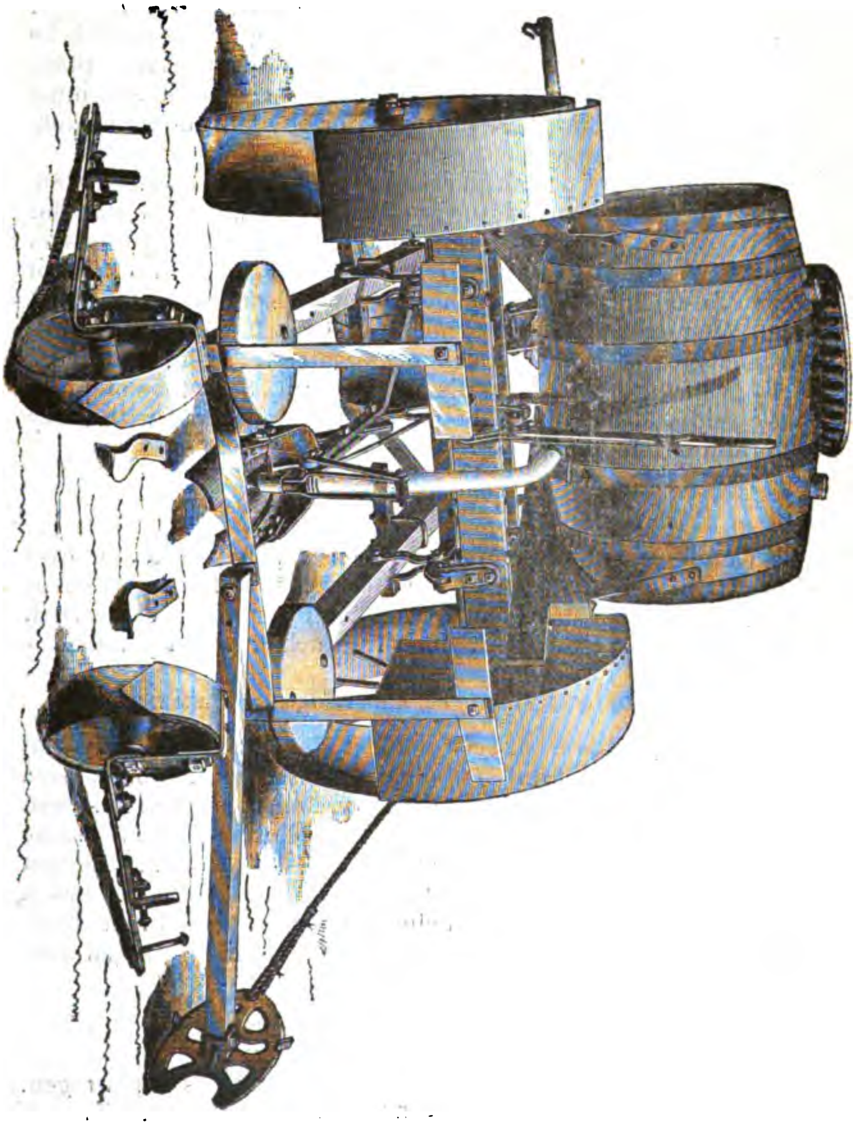
*The machine figured is the New Bemis, made by Stoddard Manufacturing Company, Dayton, Ohio. Prof. B. F. Moodie, President of the Florida Tobacco Growers Association and President of the National Cigar Leaf Association, of Lake City, Fla., is State agent for the machine. Prof. Moodie will set up and put into operation all planters bought of him.

†For a fine discussion on this subject, see B. 20, Fla. Agr. Exp. Sta., by Prof. A. A. Persons.



of tomatoes removed. If the crop per acre be the same as above stated, there would be removed from every acre 7.932 pounds of phosphoric acid; or, putting it in whole figures, it would be 8 pounds per acre. That is, 8 pounds of available phosphoric acid is shipped away in 200 crates of tomatoes, and must be placed on the acre of ground again or the land be that much poorer.

The amount of potash in every pound of tomato is .0020786. Comparing this as we did in previous cases, we learn that for every thousand pounds of tomato a little over two pounds of potash is removed. Placing the yield at two hundred crates of 60 pounds, 24.96 pounds of potash are taken out of the soil and sold. We may put this in whole numbers and say 25 pounds are removed with 200 crates of tomatoes. Then, stating it briefly, we remove 18 pounds of nitrogen, 8 pounds of phosphoric acid and 25 pounds of potash from the field with every 200 crates of tomatoes.

COMPARED WITH OTHER CROPS.

A crop of tomatoes removes twice as much potash and over 50 per cent. more nitrogen than either a crop of Irish potatoes or sweet potatoes, and nearly twice as much phosphoric acid as Irish potatoes, and more than four times as much as sweet potatoes.

EFFECT OF VARYING THE FERTILIZING ELEMENTS.

Numerous tests have been made to see what effect a variation in the amount of different elements of fertilizer would have upon the qualities of the fruit. The difference is much less than was thought it would be; indeed, different samples from the same plots show nearly as much variation as samples from different plots. In general, it seems that an abundance of potash has a tendency to produce fruit with slightly less sugar and more acid; and phosphoric acid a tendency to sweeten, while nitrogen produces luxuriant growth.*

AMOUNT OF FERTILIZER IN VINES.

The vines of an acre contain about 28 pounds of nitrogen, 4 pounds of phosphoric acid and 34 pounds of potash. This is the amount, if it is all saved to the soil, but if the vines are allowed to rot in the open air, or are burned, much of the valuable nitrogen will be lost (Md. B. 11, p. 69).

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*cf. Md. B. 11, p. 63.

From the foregoing it will be seen that more nitrogen and potash are left in the field than are taken off, and about half as much phosphoric acid. If we compare this with the stubble and roots of cow-peas, it will be seen that the tomato vines on an acre have 5 per cent. more nitrogen, two pounds more phosphoric acid and twice as much potash. In fertilizing, more of the essential elements are needed than the above figures show, because the plants do not completely exhaust the soil in a single year. Then the fertilizer is not all in an available form.

The above amount of fertilizer in the vines is altogether of too much value to be lightly dealt with. Another point in favor of making use of the vines is that it adds the much needed organic principle to our soil. It adds what so many people contend is the most important part of muck—*i. e.*, its presence aids the plants in appropiating the needed foods.

WHEN TO USE THE VINES.

There is probably no other time when there is more of the organic matter present than just at the close of the shipping season. If now these vines be turned under, and a growth of beggar-weed be started, the ground would be covered with a heavy coat of vegetation during the hot summer months, and in the fall another coat of humus be ready. This should be turned under whenever it is best for the land. There are some lands that are not hurt but greatly benefitted by turning under a crop of green manure; we are told, however, that it is not only better but absolutely necessary that only dry, well-rotted vegetable matter be plowed under, because, the green manure gives a "sourness" to the soil which it takes several years to overcome.

DO WE FERTILIZE TOO HEAVILY?

There has been much said about fertilizing tomatoes too heavily. *From all tests made in this line, indications are that there is little or no danger of fertilizing too heavily, but the danger lies in fertilizing improperly. The most vigorous vines I have seen in this State were some that received two pounds of fertilizer to the vine, besides "a lot of trash." The fertilizer was thoroughly worked into the soil and the soil well stirred to the depth of ten inches or more.

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*Cornell B. 21, p. 76.

HOW TO USE FERTILIZER.

In using compost it should be well rotted before applying, as the tomato plant wants a quick-acting fertilizer. Very often the fertilizer is used in several applications. Many tests of this procedure have been made. The average of over seventy different tests in different years shows that the largest crop of early tomatoes is obtained by applying the normal amount of fertilizer at one time. That is, the plant produces a heavier crop of the earliest pickings—the pickings that bring the money. Then it would seem that if one has only a limited amount of fertilizer it will pay better to apply it at one time. To use the fertilizer along, a small amount at a time, or apply at different times, has, in some cases, produced more fruit in the end, but in most cases it did not do this. The ground should be in a good state of cultivation, and the fertilizer thoroughly worked in and well covered. The plant should not be in direct contact with the fertilizer, nor should the fertilizer be in a bunch where the plant is to stand. One need not be alarmed if most of the fertilizer is six inches away. The plant will find it and do the better for having to go a little way to it, and for having to sort it from among the sand.

HOW TO TEST YOUR SOIL.

All parts of our State are not alike in the demands of a fertilizer. *It has been shown clearly by some that their soil does not need potash as a fertilizer. The method of proving this is as simple as it is conclusive. Three or four rows across the field, representing the average soil, are treated with a fertilizer that has no potash, as shown by the label, but in other respects is just as the other fertilizer used. Now if these four rows prove to be as good, under the same culture, as the remainder of the field, then it is clear that the potash does no good there. Then, again, this same mode of procedure could be used to test the need of phosphoric acid or of nitrogen. †There are soils that have a sufficient amount of the

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*Proc. Fla. State Hort. Soc., Pensacola meeting.

†For a full discussion of this point, see Bulletin 20 of this section; also Florida *Citizen* for Dec. —, 1893.

element in them, but do not yield it up readily enough for the plant.

The above is a cheap and simple test, and one that has saved money to the watchful farmer, and will save still more to others.

Enemies of the Tomato.

BOLL-WORM.

(*Heliothis armigera, L.*)

The tomato fruit-worm is too common and destructive to need either description or drawing. The amount of damage done to fruit last year varied considerably in different fields. As a general rule, the new fields that were somewhat removed from land that had been cultivated for a number of years had remarkably fewer worms than fields long under cultivation, or than new fields contiguous to old fields. The amount of damage gradually increased as the end of the shipping season approached. One field showed a loss of one-half of the fruit at about the last picking. Other fields lost, on an average, one out of three tomatoes. Many fields lost one-fourth of that picking.

This insect is the one that does so much damage to the cotton crop each year. Much labor and money have been expended in trying to find a suitable remedy for this pest. The small amount of food taken from the surface of the plant it feeds on renders the idea of poisoning hopeless. Some persons have been bold enough, however, to try different kinds of poison. These had some effect, but not sufficient to pay for the time and expense of applying. As a general rule, the stronger poisons killed the greater number of worms. The idea of poisoning is clearly out of reason in such a crop as tomatoes, and the use of such insecticides as kill the insect by coming in contact with it is also hopeless, since the worm spends most of its life inside of the tomato. This insect is rather a general feeder, but in all cases its habits are very similar, in that it strives to eat into the portion of the plant it uses for food.

PLANTS ATTACKED.

The greatest damage is done by it to the cotton crop. Many cotton fields have been rendered almost worthless, and in still more the narrow margin left for profit has been destroyed by these pests, the boll-worms. On corn it is also a serious pest; the worm eats into the head of the young corn and into the end of the growing ear, or even into the end of a ripe ear. The garden varieties of corn are especially attacked. It is not at all uncommon to have persons tell you that late corn cannot be raised on account of the corn-worm. The thorn-apple (*Datura tatula* and *D. Stramonium*) is attacked and eaten into in the same way as a cotton boll. When it attacks tobacco it is known as bud-worm, and the remedy usually employed is hand-picking.

A good deal of complaint was made last year of a peculiar worm in the pods of English peas (*Pisum sativum*). On rearing a number of these insects sent to the college, it was found that they were the boll-worm.

A field of fine summer, or custard, squash (*Cucurbita pepo*) was so badly infested that it was not worth the trouble to haul them to the packing house. The worms may enter this and the opening be not visible as long as the "chewings" are fresh, but after a day or two the opening becomes plainly visible.

During the meeting of the Florida State Horticultural Society, at Pensacola, some quinces were brought to the hall that were eaten into by this worm; the quinces fell as soon as entered.

DESCRIPTION OF MOTH.

The adult form of this insect is by no means well known, nor is it commonly seen. The moth is one and a half to nearly two inches from the tip of one fore wing to the tip of the other. The majority raised by us in the insect cages are about one and a half inches. The body is rather plump; about an inch long; the antennæ thread form; the color is about that of light chamois skin. The adult itself does no harm, and is probably attracted to the field by the nectar in the flowers. It flies in the evening and during the night, when the eggs are laid.

LIFE HISTORY.

The egg hatches in from two to five days, depending upon the condition of the weather. During the larval state is when the great amount of damage is done. From the first it feeds on the fruiting portion of the tomato. The smaller worms attack the smaller fruit, while the full grown larvæ usually seek tomatoes about ready to ship, or that will soon ripen.

The time from the hatching of eggs to that of pupating varies according to the conditions of the weather. During warm weather they mature in eighteen days, while in cold weather it often takes twenty-six days.*

DAMAGE.

The amount of damage that a single worm will do is not definitely known, but it is certainly greater than is usually suspected. It was not uncommon for a single worm to eat in and destroy three tomatoes in a single day, while two tomatoes were rather a normal ration; and for a large worm to stay more than a day in one tomato was rather uncommon.

After attaining full size, the larvæ find their way to the ground, dig into it to the depth of an inch or two and turn into a mahogany-colored chrysalis about an inch long. If they pass into this state late in the year they remain so during the winter; if earlier in the year, ten or twelve days are passed this way, and then the perfect insect emerges. This in a day or two begins to lay eggs for another generation.

REMEDIES.

Now, what concerns us most is when or how to take care of it to best advantage.

There are two ways that may be employed; either by artificial means or by encouraging its enemies. Just a few words in regard to the enemies. First and foremost is the common toad (*Bufo lentigunosis*). He is a very unassuming fellow, makes little noise and no great stir. But his stir happens too often for the welfare of a good many boll-worms. The time for the worm to travel is in the cool of the afternoon and evening, just the time that Mr. Toad has appointed to go out to take his recreation.

The toad is a very shy animal, and if you wish to watch his habits you must cultivate his friendship. It is almost useless to try to "slip up on him" unawares; he has too good an eye and ear. Another way is to kill and dissect them. In this way you will find gnats, flies, beetles, grubs, and in tomato fields, larvæ of various kinds, and at times moths; but the latter are rather fewer than other insects. The lesson taught by this is that we should not kill nor drive away toads. Cultivate their friendship. You will be surprised how soon you can teach a toad to expect food from you.

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*F. W. Malley, B. 29, p. 17, U. S. D. A. Div., Ento. 1891.

No worm seems to be too big for Mr. Toad to tackle, and he usually succeeds in his undertakings. It is not uncommon for him to take hold of a tomato worm that will hang from both sides of his mouth at once, and make him shut his eyes and get down on his elbows to hold. But the toad sticks right to his business, and before long he smacks his lips and chuckles all over, feeling so good after a big feast!

By walking along the fence row and brushing the trash and weeds, one will frequently drive up moths of the boll-worm and of other species. Several times, in looking for material in this way, the green lizzard, or chameleon (*Anolis principalis*, L.), has anticipated the flushing of moths and run ahead on the fence. Their quick eyes saw the moths, and before they had fairly alighted they were in the jaws of the agile little fellow.

The king,-bird (*Tyrannus tyrannus*, L.), catches quite a number of the moths as they are startled by people and by cattle. The common wasps, that build nests around in trees and shrubs do much good in carrying off many of these larvæ as they venture from one tomato to another, and while the larvæ are still young, before they have entered the tomato.

The above are some of the natural enemies of the boll-worm that every tomato grower can have more or less control over. There are many other enemies that could be mentioned and described, but they are such as would not be noticed during ordinary work.

That the above are very efficient, no one who will take the pains to study the matter will doubt; but that they are not sufficient cannot be denied. The division of entomology of the United States Department of Agriculture has spent much time in trying remedies for this insect on the cotton. It is clearly out of the question, as stated above, to use poison.

CORN AS A CATCH PLANT.

To prevent the moth from depositing her eggs on the tomato plants, a catch plant may be planted among the tomatoes. There is a good and efficient plant within reach of every tomato grower; this is corn, a few stalks planted here and there throughout the field, planting about every fifth hill in every fifth row. This attracts the moth and the eggs are deposited on the corn. The corn should be fed before the worms are large enough to pupate;

to allow the corn to mature would be simply planting a breeding place for the boll-worm.*

DESTROY WORMY TOMATOES.

A very imprudent practice by some tomato growers is to pick the wormy tomatoes and drop them in the field. It is well known among entomologists that depriving larvæ of food when they are about to pupate causes them to pupate earlier, thus this picking and dropping the tomato hastens the coming of the second brood. Again, if the worm was not quite ready to pupate it would simply hunt another vine, and find a tomato on this, and repeat the work with better appetite for the exercise.

What shall we do; not pick the wormy ones? Yes, certainly pick every one of them! Take them to the packing house and sort them; feed what wormy ones you can and the rest dump into a deep pit and cover with eighteen inches or two feet of dirt. Larvæ in pupating dig through five or six inches of dirt; to make sure that none will dig out, put on plenty.

Some growers have said that when the wormy tomatoes are not destroyed there are but few more wormy tomatoes at the next crop around the packing house than there are in other parts of the field. But it must be remembered that the greatest number of wormy tomatoes are brought in late in the tomato season. These worms transform, and by the time the moth comes out the season is over; then these moths fly to the old tomato field, or where there are other food plants. There are three or four generations of worms before the next tomato season opens, and by that time they are pretty well scattered over your and your neighbors' fields.

The tomato plants should all be plowed under and completely destroyed as soon as the crop has been gathered, as it was found by actual count last year that in those fields that grew until June 30, over half the fruit was wormy, where a month before not one out of ten tomatoes was wormy.

PHYTOPTOSUS.

(*Phytoptus*, Sp.)

A very peculiar disease of the tomato has been often noticed, and is so general that it certainly deserves attention. A number of tomato growers pronounce this the worst disease; some say it is equal to all the others combined. It is very generally known as mold. The trouble is caused by a minute animal that somehow, by its presence, causes a white, fuzzy outgrowth on the plant. The part that appears like mold is not mold at all, but an outgrowth of the skin of the tomato vine. The term mold has been occupied in another way, and is erroneously used for this disease, so it would be well to use some other. In Southern Spain ashy is used. While this may express the appearance as nearly as mold, the same objections and not too long.

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*U. S. D. A. Div. Ento., B. 24, p. 32.

Forty-three tests of fungicides and insecticides were made to find a remedy for this pest, but, as far as could be seen, they were all equally ineffective. The circumstances were all unfavorable, and so the tests cannot be pronounced failures. It is not at all improbable that some efficient remedy will be found among the insecticides. Some form of the sulphur insecticides seems about the right thing. I believe that it is claimed that these destroy by their fumes, and that it is not necessary for the liquid to come in contact with the animal. This is very important, as it is very difficult to saturate completely a branch inhabited by phytops on account of the fine, hairy out-growth entangling so much air that the phytops can live right along on a submerged branch.

As soon as a branch becomes inhabited it seems to stop bearing and do nothing but produce friz and feed phytops.

The life-history and mode of dissemination of this animal, I think, are not known. It is probable that if these were known it would be less difficult to control it than to cure the disease after it has attacked the plant.

It will require some time and labor before this knowledge can be gained, however.

NEMATODES.

A very wide-spread disease, and of many different plants, is one known as root-knot, or root-gall, caused by *Heterodera radicola*. It is claimed by a good many careful observers that this is not so bad now as it was a few years ago. It does not pay, however, to plant tomatoes on land infested by this small animal. This disease may be carried from one part of the field to another by simply taking the root of some diseased plant there and leaving it. There are many of our common weeds attacked by this worm, and care should be taken that these are not dragged about. If a field is free of it, there is no danger of the disease, if the commercial fertilizer is used, or if care be taken not to use any roots in making compost.

BLIGHT.

HISTORY.

The blight of tomatoes in Florida is caused by a fungus that is indigenous to the State. The term blight is used in a number of different States for different diseases. In Mississippi the Southern tomato blight was found by Dr. B. D. Halsted to be caused by *bacteria*. In this State there seems to be little or no confusion as to what disease shall be termed blight. Other terms are used for this disease, but where this is the case no other trouble is known as blight. It is probable that no considable portion of the State is free from it. Often it is present without the owner knowing it at all. In Lake County a field contained 13 per cent. of blighted plants without the owner knowing it. In fact, he was certain that no such thing was in his field. However, after the blighted plants were pointed out to him, he was able to distinguish them, and to help to compute the above results. In Alachua County over 7 per cent. of blighted plants were present without the owner's knowledge. Only one field of considerable size has been seen that was free from blight, and this was one that was in a good state of cultivation and had been for some time. Many attempts have been made to grow tomatoes in "fence rows;" *i. e.*, grow them nearer the fence than can be cultivated; nearly all such attempts have resulted in failure, simply because weeds that propagated this disease grew there, and, when killed, left it to attack the tomato.

In studying the disease last spring a number of fields were found that were raising the first crop of tomatoes and were as badly blighted as any of the older fields in the vicinity. One of these new fields had as much as 70 per cent. of the plants blighted before any of the fruit was shipped. At first such cases seemed to defy all explanation, but a more thorough study made the reason plain and certain. The disease known as blight will flourish on a number of garden plants, and on a number of weeds that are common to fence rows, and to old fields and those not under cultivation.

PLANTS ATTACKED.

It is quite certain that a number of plants, on which the disease will flourish, are still absent from the list, but a provisional list, with a brief description of how the affected plants appear, will be of interest to the tomato growers. No explanation will be here given as to the manner of proving that this is one and the same disease, simply because it would require pages to do so. Such plants as are merely suspected to be subject to this disease in the field, and have not yet been proven, are omitted. It requires weeks of careful work to settle whether a plant is subject to the blight, as the same cause acts quite differently on different plants.

Tomato.

When a tomato plant is attacked, if the attack is not too heavy, it shows itself by the wilting of a single leaf near a head. This leaf is usually the last fully developed leaf on that branch. This is a very important point to notice as the other diseases begin on the lowest or oldest leaves and then gradually work upward. It sometimes happens that a plant is severely attacked. In such cases the entire head hangs down as if suffering from drouth, while other heads of the same plant are looking fine. Again, it may cause the entire plant to hang down as though "struck by lightning," as some people call it. Not because it was thought that any such thing had happened—death is as sure, however. Some plants, again, will be attacked very lightly, and then live out a miserable existence. If fruit is formed, it ripens prematurely, but usually the plant has to devote its entire energies to keeping alive.

Plants suffering from blight alone show no spots on any part. Pulling the plant up and examining the roots reveals no constant characters. The drooping of the leaves and the absence of other characters is a conclusive way of telling.

If some tomato breeder has a fancy variety that should be blighted, he can save his variety by making cuttings from the wilted tops, if they are not too much wilted, and root these. Cuttings may be freely taken if only they are cut eight inches above the ground.

Every vine attacked by blight should be pulled up at once and dried; to let it grow is only propagating the disease for another year.

UofM

Moist, warm weather is the best condition for the growth of blight.

On the opposite page is an illustration from a photograph taken from a field showing the dissemination of blight. Near the bottom is the center of dispersion. If the plate contained more of the field it would show the rest of the blighted spot to be similar to the above portion.

Egg-Plant.

The egg-plant shows a yellowing of foliage, and the plan looks sickly. The lowest leaves fall off and leave the stem exposed Finally the fruit begins to fall off.

If heavily attacked, a wilting, similar to that of the toma takes place. There are no spots or other characters to tell t blight. A typical diseased plant is shown in plate II.

Irish Potato.

The Irish Potato acts much like the egg-plant when at tacked by blight. The leaves are not dropped and the plant i more tenacious of life.

The attacked plant at once sets a great number of tubers, which rarely get larger than peas or hazel nuts. It looks rather urious, when carefully dug, to see a number of larger tubers, bout the size of a hen's egg, at the proper distance from the tem, and then a great lot about the size of peas clinging closely o the stem. The potato tuber is one of the most prolific sources o propagate the blight. It is, however, only attacked when near he surface or on top of the ground.

Beans and Cow Peas.

The various varieties of beans (*Phaseolus*) and the cow pea *Dilochos*) suffer severe loss in all stages of growth. The young cow ea, or bean, usually dies before the blight matures, but the bearng plant is a fertile field for its reproduction. The cow peas and beans act very similarly when attacked by blight. The leaves turn yellow, hang down, and finally fall off, leaving the stalks standing with probably a few pods clinging to them.

On the station ground some beans were planted quite closely in the row; the blight commenced near one end and spread both ways until in one direction the row ended, and in the other there was a break of about two feet in the row. It must not be inferred, however, that the contamination took place through the leaves or vines, but it followed the roots and spread through the soil.

Squash.

The summer squash (*Cucurbita pepo*) is especially liable to its attack. Both the fruit and the vine suffer, and probably propagate the disease more than any other plant, except the egg-plant. The disease is known by a general sickly look of the plant and gradual pining away. The fruit, when attacked, soon rots down, more from the injury which admits *bacteria* and *fungi* inducing decay, than from blight.

Cabbage.

Cabbage, when attacked, looks like it had wilted down in a heap. Such plants can be lifted right off their roots. Their stems, at a line about even with the top of the ground, will be found completely rotted, while the part only an inch above and an inch below appears sound. This rotten place is where the blight made its entrance, and the decay is simply a result of the injury. The blight, before the decay has set in, has passed into the fresher portions. *Sclerotia* are produced in the last stage.

There is a bacterial disease of cabbage that may be mistaken for this; one that has probably not yet appeared in our State. The tomato blight caus s the stem to rot just at the ground line, while the bacterial disease is "characterized by a rotting of the interior of the head."*

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*H. Gaman, p. 102, Ex. Str. Bul. No. 7, U. S. D. A.

Beets.

Beets are attacked in the crown and simply wilt down.

Melons.

Watermelons and nutmeg melons show the disease by a wilting of the foliage which turns yellowish as the disease progresses. When the fruit is attacked, rotting sets in very shortly.

OBSCURE IN SOME PLANTS.

In cabbage, beets, watermelon and nutmeg-melon, the cause of the disturbance is at first altogether doubtful. The great number of other *fungi* and *bacteria* that take hold of the plant as soon as they can gain an entrance, soon overwhelm the *first cause* and before the above characters are fully manifest it is by no means easy to find the blight. Fortunately these vegetables are cheap when the marketing season is over, and it has been an easy matter to get enough blight to inoculate two hundred cabbage plants and as many beets, leaving at the same time a check plant for each inoculated plant.

Daphne Odora.

In 1892, Dr. Appell, the College physician, brought to the laboratory two fine specimens of Daphne odora that had been killed by some *fungus*. On making culture from this it was found to be the same as the tomato blight. It had destroyed the bark and cambium layer entirely around the stems at and above the ground line. There was no disease whatever in the upper limbs.

Hydrangea.

In the greenhouse on the college grounds some hydrangea cuttings were put out to be rooted. Only a very small portion of the cuttings lived; examination showed that a *fungus* seemed to be the cause. The greenhouse had been used for studying tomato blight during the summer, and the soil had been pretty thoroughly seeded with blight. Later tests, with pure culture of blight, showed that hydrangeas are subject to this disease.

WEEDS ATTACKED.

Desmodium molle, or beggar weed, is killed by blight, but does not propagate it to such an extent as some other plants, and it is a question whether serious damage would be done for more than one year.

The fire weed, *Erachtites hieracifula*, is very severely attacked, and propagates the blight to a remarkable degree. This weed is very common on new land and on land just being prepared for cultivation, as well as on sparely timbered land. It is a common weed in Florida, but not at all troublesome excepting that it makes a good *fire weed*. It catches fire easily and makes a quick, hot blaze.

Another common weed, the Canada fleabane, *Erigeron Canadense*, also called cow-tail, is severely attacked by the tomato blight. The habitat of this weed is much the same as that of fire weed, besides taking possession of old fields and of neglected fields.

Two of the amaranths, or careless weeds (*A. retroflexus, L. A. spinesus, L.*) are also killed by tomato blight.

There are many other weeds that may be added after further study. It has already been stated that there are a number of suspected hosts not mentioned here. From the above list we see that this parasite has quite a faculty for adapting itself to different hosts.

HOW BLIGHT WINTERS.

We have seen how this blight may live from early spring until late fall by simply attacking one plant, and then another, until frost comes in the fall, or until it has used up all the available material; then it simply forms a small body about the size of a number ten shot. The color of this body varies from a dull white to a dark brown, and is known to botanists as a sclerotium. It is not a seed in the proper sense of the term. As soon as the proper conditions are present, it starts again to destroy whatever it can make use of.

WHAT IS BLIGHT?

(*Sclerotium.*)

In June, 1892, I discovered the cause of this disease; not, however, until my ingenuity and almost my patience had been exhausted. The portions that showed signs of distress had been carefully studied under the microscope, and nothing abnormal could be discovered. Tomato agar-culture and others tried gave no bacteria, excepting in well advanced cases of disease, and these cultures would not induce disease in the plant by inoculation. It was quite certain that none of the species of bacteria taken from the diseased parts and grown in the culture would give the blight to the plant. In making culture from seedlings a mould appeared. This was a hint in the right direction. Following this up, I discovered that the tomato blight is caused by a minute fungus. After the cause had been discovered, over eight hundred tests with the disease on tomatoes were made. These have been carefully tabulated and show just what conditions are favorable to the growth of the fungus. The work being in a greenhouse, temperature and moisture were under good control.

Under ordinary conditions blight cannot be seen even with a microscope, but by using picro-carmine as a stain, the fine thread-like mycelia may be seen permeating the tissue of the host. The greater amount of growth is usually in the combian and soft adjoining tissue.

Another way of proving the presence of blight is to take the portion of the suspected plant and place it in a moist chamber. If the temperature is 80°-95° F. in 48 hours you will have a growth that will, in appearance, rival swan down. Fresh material, such as a slice of potato or egg-plant fruit, placed within a quarter of an inch will be siezed in a day. This bait may be carried to a second dish. Now, if the work has been done with the necessary precaution, you will have blight entirely free mixture remained on the leaves and what ran off usually fell on the ground some distance from the root of the plant. June 28th, the increase of blighted plants was 16 per cent., or $2\frac{2}{8}$ more than the average of the untreated plants. The amount of Bdx. Mx. used to each plant was the same in either case. The results of spraying the foliage were exactly the same last year. The nature of the disease was not understood at that time, so the former method was not tried. The above facts show that it is useless to spray tomato leaves for the prevention of blight. I mean spraying as the term is usually accepted. The facts further show that where the vines and soil near the vines were treated with Bdx. Mx. nearly 1-10 of the entire crop was saved by a single treatment under the most disadvantageous circumstances. On looking at it from another stand point, the loss from blight was less than $\frac{1}{8}$ of what it was in the untreated plots.

The second fungicide tested was ammoniacal solution of copper carbonate.*

Six plots were laid off and notes on these carefully taken. Four plots were treated with the solution and two left for the checks. In plots one and six the stems and ground were treated as plot one in Bdx. Mx. In the first plot a pint of fungicide was used to the plant. Here the blight, on June 28th, showed an increase of 8 per cent., or a gain from applying the fungicide, of $5\frac{1}{2}$ per cent. In the sixth plot about a quart of fungicide was used. Only two per cent. of the plants blighted after applying the fungicide. In plots three and four the leaves were sprayed in the usual way. The amount of blight was 14 per cent., or slightly more than in the checks. The above shows that Amo. Cu. Co. is a good fungicide for the blight, but it must be applied in heavy quantities. The conclusion as to how it should be applied is the same as for Bordeaux Mixture.

A solution of copper carbonate and ammonium carbonate was also tried. The results of this showed a greater decrease in the blight. In other words, the Am. Sol. of Cu. Co, as stated above, was not quite as good as a mixture of ammonium carbonate and copper carbonate.†

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*The am. sol. of cu. co. is made by wetting 5 oz. of copper carbonate with a quart of water, then add 3 quarts of ammonia water; when completely dissolved and ready to apply, add water to make 30 gallons.

†A mixture of copper carbonate and ammonium carbonate is made by mixing 3 oz. copper carbonate in a quart of water; dissolve 1 lb. ammonium carbonate in three quarts of hot water; when cool, mix and stir well; dilute to 50 gallons.

Eau Celeste was used on two plots. This is the most striking result obtained. In the plot where the stems were sprayed the increase of blight was reduced to zero, or to the lowest possible. It will be understood that not a single plot was laid off where blight was not present. It lacked, however, 1½ per cent. of being up to the normal, or 6⅔ per cent., *i. e.*, there was only 5 1-6 per cent. blight in the treated plot.

The plot left as a check on June 1st had a trifle less blight in it than the treated plot, but on June 28th there was an increase of 14 per cent., or 1½ above the average.

In the next plot the leaves were sprayed in the ordinary way. This plot showed an increase of 10 per cent. of blight.

In most of the plots treated the spraying of the leaves had no effect in checking blight, but in this plot it showed some advantage.

Three plots were laid off to try the effect of Eau Celeste.* The former order was followed.

In the first plot the stems were thoroughly sprayed and the ground about them moistened. The increase of blight in the plot was 8 per cent. The amount of blight in the plot before treatment, however, was much above the average; fully 3 per cent. The increase of blight in check was 16 per cent., so the real gain by spraying was 8 per cent. The third plot was treated just as the first and the result exactly the same.

Plots were laid off in the same way as Eau Celeste to try the modified Eau Celeste†, which is somewhat more expensive, but it has the advantage of not scorching the leaves. This has more reference to egg plant than to tomato. The results were practically the same as in the case of Eau Celeste.

The increase of blight in this was only 4 per cent., while that of the check showed an increase of 12 per cent.

A number of other fungicides were tried but these practically fall out of the list on account of their expensiveness and of their less efficiency.

The advantages above enumerated are not all that is derived from their use. A marked advantage is noticed in treated plants. The fungicides keep off diseases in general and, to some extent, insects.

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*Eau Celeste is made in the following manner: Dissolve two lbs. copper sulphate (blue stone) in a gallon of water. If the copper sulphate is powdered it will dissolve in cold water; if not pulverized, the water should be hot. Add three pints of ammonia water; keep corked until ready to use, then dilute to fifty gallons.

†This is made by dissolving two pounds copper sulphate in water, as stated above. Dissolve two and one-half pounds sal soda in same amount of water. When cool, mix the two solutions, add two quarts of ammonia and dilute to fifty gallons.

There are also many plants attacked by blight that do not succumb, but live out a miserable existence and die about the end of the marketing season. Other plants are simply cut off in the crop they would bear. After spending four weeks in the field, it was an easy matter to detect such plants. Often fruit would prematurely ripen. In some cases the main root of the plant alone was attacked; again all the latteral ones were destroyed. Some plants have a greater resisting power. This is especially true of the common plum tomato. Specimens of this plant, on favorable soil, have withstood repeated inoculation. Plants, however, of this same variety, when not on favorable soil, etc., succumb to the first inoculation. It is not improbable that a variety of tomatoes could be grown that would be more resisting to blight than those usually cultivated now. Such varieties would probably lack some desirable quality. A more profitable employment would be to ascertain just what the conditions are that the tomato most desires.

BLACK ROT.

(*Macrosporium Solani.*)

This disease is very widely disseminated throughout this State and is destructive to tomatoes in many other gardening States. From these we can get considerable information as to how it shall be treated.

This disease appears upon the vines, rarely on the leaves, and often on the fruit. When it is present on fruit, the flower end usually rots, and finally a dark green, almost black felt, forms on this. The tomato then dries up, and seemingly nothing but the skin remains. In the Northern fruit States the disease passes the winter in this form.

On the stems of the tomato the spots are more or less dark colored. It has been called the "spot," "black spot" and other names by growers. It attacks the plants mostly below the fruit. The spots appear to be somewhat sunken.

Specimens of this disease were submitted to Prof. B. T. Galloway, chief of Div. Veg. Path., by Prof. W. T. Swingle, of Eustis, so there can be no doubt as to the identity of this fungus.

This disease has been quite destructive to Irish potatoes in some of the potato growing States.

Tests of various fungicides proved that Bordeaux Mx. is a very efficient preventive, and when applied at the proper time will protect the crop more or less, according to the thoroughness of application. The proper time to apply the fungicide is when the flower buds begin to form, or even earlier in a warm season. Late cold weather retards the progress, and early moist, warm weather hastens; so the exact time cannot be stated. The fungicide should be repeated every week or ten days, depending on how rapidly it is removed by the wind and rain. The part of the plant covered with the fungicide alone is protected.

The tests made for blight were on fields that had some black rot, but the fungicides were applied too late in the season to produce any effect on the latter disease.

DROPPING OF BUDS.

There are several different maladies of the tomato the causes of which are unknown. It will be of considerable interest to watch the development of these during the coming tomato season.

Among these troubles is one that has caused considerable loss and attracted the attention of a considerable number of growers.

In this trouble, the flowers, just after blooming, fall from the vine, apparently without cause. Of course, there is a reason for this. Some growers considered the brand of fertilizer to be at fault, but that idea was not confirmed by further investigation. Still, there is not enough evidence against this to overlook the point. The frost and cold weather have also been assigned. The argument in favor of this view has much better backing than the former view.

The tomato grower, whose eyes are keen enough to see that he is losing one or two of his earliest and most valuable pickings by the falling of the early flowers, cannot be in doubt many years as to the cause of the disorder.

ANOTHER DISEASE

that causes the crumpling and drying up of the leaves has been observed in many places and in widely different sections. It has been thought that it was caused by hot sun burning the leaves;

by others the brand of fertilizer has been blamed. While the cause is obscure, the damage is decidedly obvious. Often all the foliage will be dry and functionless, while there are still green tomatoes on the vines. The disease grows worse as the season advances. Often before the bearing season is over the vines are dried up with tomatoes hanging to them.

These diseases, for which remedies are unknown, will be studied during the coming season. And work will be continued on those diseases mentioned above which appeared to be helped by the applications mentioned.

Bulletin No. 22. November, 1893.

FLORIDA

AGRICULTURAL EXPERIMENT STATION

CHEMICAL DEPARTMENT.

FERTILIZERS:

How to Make and How to Use Them.

By A. A. PERSONS.

The Bulletins of this Station will be sent free to any address in Florida
upon application to the Director of the Experiment
Station, Lake City, Fla.

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FERTILIZERS:

HOW TO MAKE AND HOW TO USE THEM.

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INTRODUCTION.

In Bulletin No. 20, of the Station series, which was devoted to a discussion of Soils and Fertilizers, a few elementary principles referring more especially to the chemistry of farming were carefully emphasized. The object of the writer was to make a simple and practical explanation of certain scientific terms that must find frequent employment in our Station publications, and terms which no one can be expected to comprehend and employ most profitably, unless their full meaning has been clearly stated. The generous reception that this Bulletin has met with from press and people alike all over the State, has been a source of satisfaction and encouragement to the Station authorities, and the demand for it has been almost unprecedented in the history of the Station publications. If those who were the recipients of Bulletin No. 20 are familiar with its contents, they are entirely prepared to utilize the present Bulletin to the best advantage, for what will be found in these pages is only the practical employment of those principles which previously have been explained.

The salient features of the previous publication included a brief discussion of the soil elements and its liability to become deficient in one or more of them under a prolonged system of cropping. This explanation naturally led to a discussion in regard to the use of fertilizers as a means of restoring either of them to an exhausted soil. It was also remarked that in the present stage of agricultural progress in the United States, it seldom occurs that more than three of these essential soil ingredients will be found deficient in the average soil. These three are Phosphoric Acid, Potash and Nitrogen, and only these, therefore, under ordinary circumstances, need concern the farmer when he is desirous either of restoring or else of preserving the fertility of his land. The mode of occurrence of these several substances in nature and the various sources whence each is obtained when employed in the manufacture of commercial fertilizers, were carefully pointed out, together with an explanation of a chemical analysis of a fertilizer and a method of computing their commercial values. Attention was likewise directed to the merits possessed by many so-called "home manures," and the necessity for preserving and employing them as plant-food material was strongly urged. Undoubtedly, all over Florida, there prevails at this time a system of reckless extravagance in dealing with this material, and as a result, thousands of hard earned dollars are annually taken from the pockets of our farmers and appropriated to purchasing commercial fertilizers which could as well, or even better, have been expended for articles more necessary, if only a little intelligence and economy had been exercised in dealing with various waste materials and natural manures occurring about all premises.

It is the object of the present Bulletin to continue the discussion previously entered upon, by pointing out the fertilizing values possessed by the several substances, and how each can be most economically preserved and employed in enriching the soil. "How to make and use" fertilizers—both domestic and commercial—will be carefully explained, and practical examples, illustrating each explanation, will be given, so that after carefully studying the Bulletin's contents, each farmer will have acquired information sufficient to enable him to buy intelligently, and use economically any kind of fertilizer that need engage his attention. Not only so, but he will be entirely competent to buy the unmixed raw materials and compound them into any high or low grade fertilizer, or any special fertilizer, containing an unusual quantity of some particular element he may desire. At the end, will be given a table showing the chemical composition of commonly occurring substances, both animal and vegetable, that are useful for enriching the soil, and in connection with that table, it will be explained how to utilize any of the several substances enumerated in the list, in making at home, and for home use, a fertilizer containing the desired amount of any particular substance, i. e., of either Phosphoric Acid, Potash, or Nitrogen. Before entering upon the details of these several explanations, however, it may be desirable, even at the risk of repetition, to lay down a few chemical principles which we should all have in mind before we can be in a position to understand the several explanations which are to follow.

The successful farmer of to-day is the one who follows his profession in a scientific manner. The orthodox system of farming, such as was practiced by our forefathers, was probably well adapted to the environments of those times, when rich and virgin soils were plentiful, and when all that was needed to induce a soil to yield a bountiful harvest, was simply to "scrach its back" with plow and harrow, and then leave it to smile with fruits and flowers and vegetables and grain. Owing to the continuous system of cultivation to which our soils have, since then, been constantly subjected, and without fertilization, they scarcely now serve more than as a medium, or means of conveyance of plant food from the earth into the plant. If, therefore, we are to prosper as farmers, we must alter our system of farming—of sowing, reaping, fertilizing, etc., to suit the changed conditions. We must emerge from the chrysalis of primitive agriculture, as practiced, by our ancestors, and seek to learn more and more of the teachings of science as related to our profession, if we would solve the problem of our prosperity. In all cases it is absolutely necessary that thought go before work, and in every instance the successful farmer of to-day invariably has a theory upon which to base his practice. No farmer can any more understand the principles that underlie the science of fertilization without some knowledge of the chemistry of soils, of plants, and of fertilizers, than could a railway be accurately planned and constructed by one unskilled in the sciences of mathematics and mechanics. Indeed, the farmer without his reasons, his theory, if you please his science, can have no plans. With these wanting, agriculture would prove as complete a failure with him as would the banking business when he was entirely ignorant of all the laws of finance.

In years gone by the farmers had but little use for agricultural chemistry. The rich and virgin soil usually chosen by the farmer of former times were quite well supplied with all the substances needed for plant nutrition, and all that was needed was simply for the farmer to stir the soil occasionally, and reap abundant harvests. But since then times and conditions have changed. Under a continued system of cultivation, and the consequent drainage of plant food by a constant removal of crops, without a proper replenishment of this nourishment to the soil in the form of a fertilizer, it has grown weary and hungry. It now looks for food, coaxing and petting, before it can be induced to supply remunerative yields. We, therefore, find ourselves burdened with duties that were not imposed upon our fathers. The foremost and most formidable task which to-day confronts us as farmers, is that of providing the raw materials required for the manufacture of the crops that we desire to grow—and that, too, at prices that will yield us a just and reasonable profit on our investment. These raw materials are expensive. If we purchase them carelessly and apply them injudiciously, or indiscriminately, we will be sure to find ourselves losers in the transaction.

The Province of Chemistry.

It is just here that chemistry comes to the farmer's rescue, and enables him to solve many of the problems concerning the needs of his crops; the nature and value of various raw materials for different fertilizing purposes; and to make and use fertilizers with a mind to both wisdom and economy.

Briefly mentioned, the chief benefits to be derived by the farmer from a knowledge of chemistry, may be thus defined:

1st. It teaches the composition of soils, of plants, of fertilizers, and of the atmosphere, and tells how to conform one to the requirements of the other.

2nd. It determines both the variety and quantity of the food that different plants require for healthy and vigorous growth.

3rd. It gives information in regard to manufacturing fertilizers, and explains how all kinds of refuse matter occurring about either the slaughter house or the premises, may be made useful in manufacturing wholesome food for plants. Much more has chemistry done toward solving agricultural problems, but what has been pointed out above will be quite sufficient to subserve the purposes of this bulletin.

How Chemistry Aids the Farmer.

To explain how chemistry is of such substantial aid to the farmer, it is only necessary to say that the chemist, in his investigations, proceeds to analyze the soil, the plant, the atmosphere, and fertilizers, and having thus acquired a knowledge of their several properties and constituents, he is in a position to proceed in an intelligent manner to conform one to the needs and requirements of the other.

The Composition of the Soil.

Among other things, we have learned from chemistry that the soil we cultivate is usually made up of from fourteen to fifteen elements when in a healthy state for cultivation. (By the term "element" is meant: A simple substance which cannot be further subdivided into two or more kinds of substance possessing different identities.) In all, there are now know to the chemist about seventy of these elements, but only about fifteen of them occur in soils, generally, and these fifteen are all that are believed to be essential, either to plant or animal growth. It, therefore, becomes us as farmers to concern ourselves only with such of them as must be present before our soils can possibly produce profitable crops.

Of these fifteen elements which are regarded as indispensable to the fertile soil, seven are designated by the chemist as "non-metallic," and eight as "metallic" elements. The "non-metallic" elements are oxygen, nitrogen, carbon, silicon, sulphur, phosphorus and chlorin, and the "metallic" elements are hydrogen, potassium, sodium, calcium, magnesium, aluminum, iron, and manganese.

The chemist has been accustomed for a long time to divide the elements into "organic" and "in-organic" elements. For many years those included under "organic" were such as appeared to be destructible by fire, and those comprising the list of "in-organic" elements were such as were incombustible, or such as remained as a residue, or ash, whenever a plant was burnt. In recent years, however, the barriers between organic and in-organic chemistry have been rapidly giving way, and the agreement is now univesal among chemists, that an element may be either organic or in-organic, according as it is, or is not, a part of an organized body.

The plant-forming elements naturally group themselves into two distinct divisions, which are marked by well defined and widely varying characteristics. The first includes those elements that are derived exclusively from the air; the second refers to those which are furnished exclusively by the soil. And thus we have two distinct classes of elementary substances entering into the composition of plants, both of which are equally essential to their life and growth. Those elements comprising the first class, and which are derived by plants, either directly or indirectly, from the atmosphere, are only four in number, viz.: Carbon, hydrogen, oxygen, and nitrogen. These four air-derived elements constitute much the larger proportion of all plants, forming from 95 to 99 per cent. of their entire weight. When plants are burnt, or when they undergo decay, these atmospheric elements mostly pass off into the air in the form of gas. It must not be inferred that because these elements are a source of atmospheric plant food, they are always derived by plants directly from the air, for such is not the case. True, plants do obtain large quantities of their food in this way, but it is likewise true that the air-derived elements are always present in the soil, in combination with the soil elements, and forming what are called chemical compounds.

It must not be inferred that because the soil-derived elements (i. e.: phosphorus, sulphur, chlorin, silicon, calcium, iron, potassium, sodium, magnesium, etc.) occur in such small proportions in plants, they are not equally as essential to growth as are the more important air-derived ones, for such is not the case. Though all of them combined constitute only from one to ten, or twelve, per cent. of the entire weight of plants, still they are just as essential to growth as are the more abundantly occurring air-derived ones, and the entire absence of a single one will materially retard the vigor of any crop.

Why We Fertilize.

From accurately conducted experiments chemists have learned that though all plants must have a nourishment of each of the elements enumerated above, no two plants, even of the same variety, consume precisely the same quantity of each; neither do different families of plants require the same elements in identical proportions. This discovery naturally offered an explanation for the exhaustion of soils by a continuous system of cropping, and demonstrated, most emphatically, the necessity for using fertilizers if the fertility of the soil is either to be maintained or restored.

The Lesson Taught.

We have also learned from the chemical lesson cited above that the elements most largely drawn upon by growing plants are three in number, to-wit: Phosphorus, potassium and nitrogen, and the supply of these elements, therefore, will become exhausted in a soil earlier than all others when it is subjected to a continuous system of cropping, and we then find ourselves confronted with the necessity either of replenishing such a soil with them, or else ceasing to produce good crops. In practically all the cultivated soils of Florida, and, indeed, of the entire country, all of the other essential elements are present in the soil in sufficient quantities to last for years to come. There is little probability of the early exhaustion of either of them, and in estimating the fertility of his land the farmer of to-day rarely finds it necessary to take any account of them, but in a sterile or worn soil it will be found that one, two, or all three of the elements—phosphorus, potassium and nitrogen—are deficient, and this deficiency will have to be made up, and the only process by which this can be accomplished is known as fertilizing, which simply means adding to a poor soil certain materials which will contribute to it the necessary quantities of phosphoric acid, potash and nitrogen to insure a profitable yield of agricultural products. The material used for this purpose may be either homemade (i. e. stable manure, pea vines, saw-palmetto root ashes, etc., etc.), or they may be applied in the form of artificial or commercial fertilizers (i. e. bone meal, phosphate, sulphate of potash, nitrate of soda, cotton seed meal, etc.).

Definitions of Fertilizers.

Before proceeding directly to a discussion of various kinds of home and commercial fertilizing material that is available for enriching the soil, it will doubtless be well to offer a few explanations which will enable all better to understand the real worth of different kinds of material for fertilizing purposes; i. e. what essential element or elements of plant food any particular substance will contribute to a soil when it is applied.

First, then, we will remark that a fertilizer may be either a partial or a complete one, according as it contains one, or two, or all three of the essential elements (phosphorus, potassium and nitrogen) in proper proportions. Thus, acid-phosphate is a partial fertilizer. It contains only one of the three essentials, i. e., phosphorous. Sulphate of potash is a partial, or incomplete fertilizer, because it contains only potash (Potassium). And nitrate of soda is also a partial fertilizer, because it contains only nitrogen. A combination of any two of these, that is of acid phosphate and sulphate of potash, or of acid phosphate and nitrate of soda, will still be an incomplete fertilizer mixture, but a combination of the three, in proper proportions, would give a complete, well-rounded fertilizer, because the acid phosphate will contribute the necessary phosphoric acid, the sulphate of potash, the necessary potassium, and the nitrate of soda the required amount of nitrogen. This latter combination is the form whose application is usually found to be most profitable to the average cultivated soil.

Seldom a week passes without the chemical department of the station receiving a letter of inquiry, couched in language about as follows:

"I have a plantation which has been in constant cultivation for a number of years. For a long while, the soil never failed to yield a good crop, but of late, it matters not what care is exercised in cultivation, it is never possible to induce it to make anything like a satisfactory yield. In the past the soil has received very little fertilizer treatment, but of late I have tried, first, acid phosphate, and afterwards nitrate of soda, neither of which seemed to afford any very marked benefit. Can you suggest to me any form of fertilizer which will enable me to restore to my soil the fertility that it once possessed?"

This is a fair illustration of letters that we are almost daily in receipt of, and the answer which is always sent, is found, in substance, in what has already been said.

Where crops have been constantly growing, and in harvesting carrying out of a soil a large quantity of all the three essential elements which they draw so largely in growth, and which usually are present in soils in smaller quantities than any of the others, it is but a simple proposition that their exhaustion in soils will occcur much earlier than that of those occurring in larger quantities, and of which plants consume less. Now what will be the result? If such a soil has never received a fertilizer treatment, and if crops have been constantly grown upon it, is it not clear to all that its failure to produce abundant harvests (barring external influences) is due to the fact that it has become exhausted of one or more of those elements which plants must have before they can grow? And it may be safely concluded that under such a continued system of cultivation as has been described in our correspondent's letter, that the soil will be found sorely in need, not only of one, but of all three essential elements to which reference has been made.

Where, then, is fault to be found with the system of fertilizing practiced by our correspondent? Clearly, he is not using the kind of fertilizer which will replenish the soil with all elements of which a system of cropping has deprived it. In the first case, he gave his land a dressing of phosphate, which only enriched it with phosphoric acid; and in the latter instance, an application of nitrate of soda was administered, which only afforded nitrogen. In the first case, the soil lacked both nitrogen and potash, and in the latter case, both potash and phosphoric acid. Instead, then, of applying only one of the forms of material in a single season, he should have applied both and should have supplemented them with a proper proportion of potash in some commercial or natural source. In other words, the doctor's prescription for his sick or imperfect soil is a complete, well-rounded fertilizer.

But it is very often the case that some special crop will require more than a normal amount of some particular form of plant food. For instance, tobacco needs a much larger supply of potash for perfect growth than many other crops require, and the same may be said of fruit crops in general. Since it naturally follows that where one of these several crops is grown continuously on the same plot of land, such a plot will become exhausted of its store of potash sooner than of any other plant food substance, and, of course, in such a case, only a form of potash fertilizer need to be applied, or, better still, in order to maintain the fertility of such a soil, it will be found judicious to apply to it from time to time a complete fertilizer mixture (i. e., one containing potash, phosphoric acid and nitrogen) in which the ratio of potash to phosphoric acid would be as 3:1 and the ratio of potash to nitrogen about as 1½:1.

We see, therefore, that in the case of special crops, requiring an over-amount of some particular element, the proper variation in the proportion of such an element must be taken into account in compounding the fertilizing mixture with which such crops are to be nourished. Such a mixture may be aptly designated, "a special fertilizer."

To illustrate the various proportions of the several fertilizing elements removed by different crops from soils during growth, we append, just here, a table showing how many pounds of phosphoric acid, potash and nitrogen are withdrawn, per acre, by an average crop of the different varieties mentioned.

The table is commended to our farmers for careful study, because its thorough comprehension will afford an insight into the kind of fertilizer that will be best adapted to growing any special crop enumerated in the list. It will afford a knowledge of how a mixture can be best compounded for economical use, so as to furnish a healthy nourishment for both soil and plant, and at the same time guard against the extravagant use of any kind of plant food.

TABLE SHOWING HOW MANY POUNDS OF THE CONSTITUENTS MENTIONED ARE WITHDRAWN, PER ACRE, BY AN AVERAGE CROP.

	POTASH. (LBS.)	PHOSPHORIC ACID. (LBS.)	NITROGEN. (LBS.)
Apples—15 tons per acre	45	3	30
Pears—10 tons per acre	36	10	12
Plums—2 tons per acre	8	2	16
Grapes—4 tons per acre	40	12	13
Berries—1½ tons per acre	7	2½	....
Sugar Beets—20 tons per acre	72	12	110
Carrots—20 tons per acre	150	24	70
Mangolds—20 tons per acre	160	18	90
Turnips—20 tons per acre	110	25	75
Onions	96	49	96
Cucumbers	193	94	142
Lettuce	72	17	41
Cauliflower	265	76	202
Cabbage	514	125	213
Rape	124	79	154
Wheat	58	45	111
Rye	76	44	87
Barley	62	35	78
Oats	96	35	89
Rice	45	24	39
Corn	174	69	146
Corn Fodder (green)	236	66	122
Meadow Hay	201	53	166
Sorghum	71	68	129
Sugar Cane	107	37	518
Tobacco	148	32	127

The above table will suffice to show that a fertilizer properly compounded for a fruit orchard is not an economical one for use on cereal crops, such as wheat, barley, rye, etc. Neither does a fertilizer mixture which is well adapted to vegetable growing meet the requirements of ordinary farm purposes.

In the case of fruit crops it may easily be observed (though the figures are only approximately correct) that they often remove from the soil an amount of potash ten or fifteen times as large as that of phosporic acid, and yet we often see so-called special fruit fertilizers advertised for sale, in which the proportion of phosphoric acid guaranteed is double that of either potash or nitrogen.

The usual forms of complete fertilizer mixtures for sale in this state contain, on an average, about the following proportions of the several fertilizing elements:

Phosphoric acid......	8 to 10 per cent.
Potash	4 to 5 per cent.
Nitrogen	4 to 6 per cent.

From chemical analyses of the soils of various sections of Florida made in this laboratory, it is made apparent that the soils of this state are universally more deficient in potash than any other element, while phosphoric acid is more generally diffused throughout the soil than either of the others. This fact, taken into consideration along with the other fact that, generally speaking, the character of the crops grown throughout the state is such as requires a predominance of both potash and nitrogen, it would seem, to say the least, that a majority of the fertilizer combinations put annually upon our markets for sale are ill adapted to fruit and vegetable growing. The writer is of the opinion that, as a general rule, it would be well for our manufacturers to reverse the proportions of many of the fertilizer formulas that they are daily commending as admirably adapted to fruit growing, and have the constituents proportioned about as follows:

Phosphoric acid.....	5 to 6 per cent.
Potash	10 to 12 per cent.
Nitrogen.............	6 to 8 per cent.

It is confidently believed that a mixture compounded in accordance with the above formula will, in a great majority of instances, yield results far more favorable in the case of fruit crops than the ordinary routine formula that our fruit growers have been accustomed to use for years.

And what has been said with regard to fruit tree fertilizers applies with equal force to vegetable growing.

Fertilizers—How to Make and Use Them.

With what has been said in explanation of fertilizer terms, the chemistry of fertilizers, and the care that is to be exercised in compounding them judiciously (i. e. with special reference to the requirements of the crops to be grown), we are in a position to proceed intelligently to study the different sources, both natural and commercial, whence each kind of fertilizing material may be easily obtained.

It is no uncommon thing to hear a farmer say that phosphate, or cotton seed meal, or ashes, or pea-vine, placed upon his land will serve to enhance its fertility, and thus insure larger crop returns in the season of harvest; but if that same farmer be asked what element of fertility, phosphate, or bone meal, or cotton seed meal, etc., contributed to soil enrichment, in a great majority of cases he will be unable to answer you.

The object of the present bulletin is to diffuse knowledge along these very lines. It is the design to study with much care many of the more commonly occurring forms of material, which occur in profusion about almost every farm premises, with a view of acquainting our farmers with the availability of such substances for fertilizing purposes, and inducing them to pursue such methods as may be suggested for properly saving and employing such materials (which now through carelessness are allowed to go to waste) in enriching the soils they are compelled to cultivate.

After covering this phase of the scope of the bulletin, it is the intention to refer to the more commonly available soures of the three fertilizing elements in the form of commercial fertilizers, and subsequently show how each farmer may, for himself, prepare his formulæ at home, and of any specific proportions desired, so that any special crop will be sure to receive just such a fertilizer ration as will seem best adapted to subserving its requirements.

Natural Fertilizers.

First in order, then, will come the consideration of natural fertilizers, many of which only benefit a soil in a mechanical way, and are appropriately designated as mechanical manures.

This subject of natural manure is one of immense importance to economic and scientific agriculture. Undoubtedly our farmers make a serious mistake in failing properly to employ for fertilization the various forms of refuse material that exist on every farm. The writer has often had occasion to refer to the different systems of farming practiced in the North and the South. The economic and intensive system of agriculture carried on in the Northern States he has frequently contrasted with the system that is prevalent among us, and he has made earnest appeals for an improved, economical system of farming in Florida.

To bring into usage this improved system, our methods of dealing with natural fertilizers will have to be revolutionized. The extravagance that characterizes our present methods of dealing with them will have to give place to more prudent, intelligent and economical ones. These natural manures must be collected and preserved with as much care as is now bestowed upon the commercial fertilizers which the farmer is compelled to purchase.

The various natural fertilizers occurring about every farm have just as really an agricultural value as have the more concentrated forms of commercial fertilizers. Just in proportion, then, as their merits are appreciated and they are carefully collected and preserved for farm use, will the necessity for purchasing artificial fertilizers diminish, and the money which would have been expended in their purchase be saved. With a view to impressing the farmers with the immense importance of this subject, as a factor in their prosperity, we shall suggest desirable methods for saving these manures so that the soil may receive the largest possible benefit from their application.

In the list of natural manures there are certain ones which are useful chiefly on account of the fact that they improve the physical character of the soil. Of course, in addition to their physical, or mechanical efficiency, they also contain small quantities of plant food and thus contribute, in a small degree, to the nourishment of plants. Their chief value, however, is due to the mechanical effect they have upon soils. Such a class of fertilizers is usually designated by chemists as

Mechanical Fertilizers.

In the list is usually included organic matter of various kinds, both animal and vegetable. Chief among such manures may be mentioned grass, leaves, straw, cotton hulls, plant roots, corn stalks and woody matter of various descriptions. Other vegetable matter, such as peavines, cotton seed meal and cotton seed are also mechanical manures, but they contain a much larger quantity of real nutriment (i. e. nitrogen) than those previously mentioned, and are therefore to be prized not only because of their mechanical effects, but also on account of their chemical constitution. When any of these mechanical manures are plowed into the soil, they soon begin to undergo decay, and their decomposition serves to render the soil porous, loose and open. The effect is greatly to improve a soil's mechanical condition by facilitating the admission of air and water, thus hastening the "weathering" process. Mechanical manures also absorb water and thus tend to keep the soil moist. They likewise absorb heat, and thereby contribute, in a manner, to the warmth of soils. As they decompose, certain acids are formed, which begin at once to act on the mineral matters in the soil, making them more soluble. Of course, the rapidity of decomposition in mechanical manures varies greatly with the character of the substance; and the rapidity of decomposition will measure the immediate benefits that the soil receives from them. Thus, peavines, leaves, grass, etc., will decompose more rapidly than corn stalks or cotton stalks; and so, crushed cotton seed or cotton hulls will decay more readily than either uncrushed seed or cotton seed meal. When either of the forms of mechanical manures enumerated above is to be employed, it will always be found advantageous to subject it to partial decomposition in a prudent manner before applying it to the soil. The process by which this is done is usually designated "rotting" the manure, and it is easily accomplished simply by placing the material that is to be used, such, for instance, as stalks, straw and cotton hulls, first in the stable to be used as litter, and subsequently transferring it to a compost heap, judiciously constructed, and there allowing it to remain for several months or until ready for use.

Woods-earth and muck are, too, generally referred to as mechanical manures. Each, when properly collected and treated, will prove beneficial to a soil, both mechanically and chemically, but neither of them is usually as rich in fertilizing substance as many of the mechanical manures already mentioned. On soils that are well nigh destitute of organic substance, both will be likely to produce excellent results, and they should be highly esteemed. The physical character of leaf-mold, being easily disintegrated, renders its application easy, and enhances its value as a mechanical manure.

We quote below for the information of the farmers, the quantity, in pounds, of the three fertilizing constituents, phosphoric acid, potash and nitrogen, contained in 1,000 pounds of vegetation usually included in the list of mechanical manures. In studying the fertilizing composition of the several substances, it should be remembered that it is not solely on account of the number of pounds of the several elements of plant food enumerated above that these materials are valuable, but also on account of the mechanical improvement already spoken of that they produce.

TABLE SHOWING THE NUMBER OF POUNDS OF PHOSPHORIC ACID, POTASH AND NITROGEN OCCURRING IN 1,000 POUNDS OF MECHANICAL FERTILIZER MATERIAL.

	Phosphoric Acid.	Potash.	Nitrogen
Crab Grass (green)............	0.75	0.40	4.00
Crab Grass (dry)..............	2.50	1.50	15.00
Ordinary Weeds (average)......	1.00	0.75	10.00
Oat Straw.....................	2.00	12.40	6.20
Wheat Straw...................	2.00	5.10	5.90
Corn Stalks	3.00	6.00	3.20
Corn Cobs	0.60	0.60	5.00
Cotton Stalks, Bolls and Leaves..	3.00	15.00	14.00
Cotton Hulls	2.80	3.00	7.50
Oak Leaves (dry)..............	2.60	1.70	10.00
Pine Straw....................	0.70	0.30	6.00
Pine Wood (saw dust)	0.07	0.08	5.00
Oak Wood (saw dust)	0.50	1.40	10.00

Among mechanical fertilizers that are valuable for their high per cent. of fertilizing constituents as well, are the following. This table, like the preceding one, shows the number of pounds of each of the several constituents occurring in 1,000 pounds of the several materials:

FERTILIZING CONSTITUENTS IN 1,000 POUNDS.

	Phosphoric Acid.	Potash.	Nitrogen
Cotton Seed..................	10.00	12.00	30.00
Cotton Seed Meal............	25.00	17.50	67.50
Linseed Meal................	17.50	13 50	56.00
Pea Vines (green)............	1.00	3.10	2.70
Pea Vines (dry)..............	5.20	14.50	19.50
Pea Vine Roots (green)........	1.50	4.50	4.10
Clover (green)................	1.00	4.90	4.30
Clover (dry).................	3.80	22.00	20.70
Clover Roots (green)..........	1.25	5.00	5.20

The above figures represent the average of various analyses made in different laboratories throughout the country, and may, therefore, be considered reliable.

If farmers will carefully preserve this bulletin they will be sure to find the above tables of great service. They will have occasion frequently to refer to them when it is desired to know the real fertilizing value of any substance included in either of the tables. The figures given should serve to impress every one who is desirous of farming economically with the high value that many of the substances possess. They should also serve as a warning to all who have been careless in regard to the use of such material that they must be more economical, if they ever expect to make their vocation remunerative.

Other Mechanical Manures.

Thus far what has been written in regard to mechanical manure has been with special reference to those which are of vegetable origin. It is in order now to make mention of forms which are of animal origin, and in this list the several varieties of animal excrement will be included in the discussion under the general heading:

Farm-Yard Manure.

The various forms of animal manure may also be said to be comprised in that list of mechanical and homemade fertilizers which are valuable to be applied to soils, both on account of physical and chemical properties which they possess. Under "farm-yard manure" is included the excrement, or droppings, from all kinds of farm animals. Such manure, properly preserved, should consist of both the liquid and solid excrement of farm stock, together with straw occurring along with the manure, and which was employed as litter. The composition of such manure will naturally vary according to the character of the animal, the quality of the food it received, and the proportion and variety of the litter employed. If the animal voiding the excrement be an adult, and neither gaining nor losing weight—such, for example, as a working horse—the excrement will contain approximately the same quantity of nitrogen and ash constituents that was present in the food the animal received. But if the animal be one which is constantly increasing in size, or producing young, or furnishing milk or wool, then the nitrogen and ash constituents of the voided excrement will be perceptibly less than the quantity originally present in the food, and the difference will have gone to what is called "animal increase." Manifestly, the manure obtained from the latter class of animals will be inferior to that obtained from the former, provided, of course, that both kinds receive the same quantity and variety of food. It follows that we should not expect as valuable manure from a milch cow as from a dry one, or from a growing colt as from a full grown horse, or from a growing pig as from a well grown porker.

The character of the food eaten by the animal will affect the quality of the manure, even more than it is affected by the character and age of the animal. A diet of corn-fodder or straw can yield only an inferior quality of manure, simply because these foods contain only a very small quantity of either of the essential elements of plant food. A diet of cotton seed, cotton seed meal, peavines, or oil cake, etc., will, on the other hand, yield a very rich manure, because these foods are rich both in nitrogen and ash constituents.

What Farm-Yard Manure Is.

From a chemical standpoint the composition of barnyard manure will average about as follows: In a comparatively fresh state, the per cent. of water will range from 65 to 80. The nitrogen will vary from .0.40 to .0.65 per cent., and higher, if produced from well-fed animals. Exclusive of sand, etc., which are always present, the ash constituents will run from 2½ to 3 per cent. Of the ash constituents, from 40 to 70 per cent. will be potash, and from 0.20 to 0.40 per cent. will be phosphoric acid. A ton of farm-yard manure will, therefore, average from 4 to 9 lbs. of phosphoric acid, 9 to 15 lbs. of potash, and 9 to 15 lbs. of nitrogen. Estimating its farm value on the strength of its fertilizing constituents alone, (i. e., regardless of the beneficial mechanical influence it exerts when applied to a soil), it should be worth from $2.50 to $4.00 per ton (2,000 lbs.)

Farm-yard manure may be said to be a "general" manure, because it supplies all of the essential elements of plant food. The immediate returns (crop productions) from an application of farm manure (in an undecomposed state) are much less than from the same amount of plant food applied in the form of artificial fertilizers, because in the case of the former, the effect of an application is spread over a period of several years. Its nitrogen is chiefly present, not as ammonia, but in the form of carbonaceous compounds, which decompose much more slowly in the soil, and to overcome this and make sure of a sufficient supply of available plant food in a single season, it is always desirable when fertilizing with farm-yard manure to supplement their application with a moderate quantity of commercial fertilizers. Of course, the quantity of the latter that it will then be necessary to employ will be much less than it would have been had no home manure been used.

The Treatment of Manure.

We come now to the most important feature of the discussion, viz.: the proper treatment of home manures, (both vegetable and chemical), when it is desired to employ them so as to reap the greatest possible benefit from their application.

In reckoning the true fertilizer value of any variety of manure, a great deal depends upon the kind of treatment to which it has been subjected. Thus, when stable manure is piled into heaps and left to decompose, exposed to sun and rain in the barn-yard, without any form of shelter, it will lose fully one-half of its value as a fertilizer.

Animal manure (excrement, etc.) decomposes much more rapidly than vegetable matter, and when mixed with the latter cause it to decompose with more rapidity than it otherwise would. The facility with which it readily undergoes the "rotting" process admirably adapts it to the purposes of a mechanical manure. It is also generally true that animal matter is richer in plant food, especially in nitrogen, than vegetable matter, and if during the heating process the proportion of animal to vegetable matter is unusually great, there is danger of enough heat being produced to cause much of the nitrogen to be driven out of the heap in the form of a compound known as ammonia, unless precautions are taken to retain this volatile substance intact. This may be done by sprinkling over the manure pile from time to time a liberal quantity of gypsum, or land plaster (sulphate of lime). The same results could be largely accomplished by mixing with the manure a sufficiently large amount of litter to reduce the relative proportions of animal matter in the manure, or where the mixing with litter is done in the stalls before the excrement is transferred to the permanent heap. The same results are accomplished by frequently changing the litter so as to prevent it from becoming oversaturated with the excrement.

The overheating of manure heaps can also be prevented in a measure by occasionally wetting it. Perhaps it will be safe, in any case, to prevent the escape of ammonia by supplementing either method of treating manure. A little gypsum, powdered earth (clay) or some porous material which is known to be a good absorbent, should always be added. Such material, applied either to the manure heap or in the stall, will likely be advantageous in preventing the volatilization of ammonia.

Protection from Rain Necessary.

The plant foods in farmyard manure speedily become soluble in water. Such manure should therefore be protected from rain to prevent leaching. A large proportion of the nitrogen in animal refuse is voided in the form of urine, and, generally speaking, the richer the diet, the higher will this proportion be. If, therefore, the manure is exposed and allowed to be washed by rain, and these washings allowed to drain away, much loss of valuable material will surely occur. To this fact is attributed the superiority of "box" manure, or that collected in stalls and under shelter, over that which is collected and rotted in an open lot.

It should also be remembered that urea, which constitutes the chief nitrogenous ingredient of urine, is speedily changed by fermentation into carbonate of ammonia, which is very volatile, and which will speedily escape if means are not ready at hand for catching and retaining it in the heap as fast as it is produced by fermentation. When the fermentation goes on in a place protected from rain, carbonaceous matter is destroyed, but very little nitrogen is lost provided the proper means for retaining it have been provided. The rotted manure when well made is more concentrated than the fresh, having lost much weight during fermentation, with comparatively little loss of valuable constituents.

Any kind of vegetable substance which is to be appropriated for manurial purposes should also be cared for in a similar manner to that proposed for farm-yard manure. By storing it in the protected compost and allowing it to decompose along with animal droppings, a home manure possessing a high agricultural value will be secured.

Each farmer who has been careless in his methods of collecting these manures, or who has entirely disregarded them in his farm operations, should be convinced that his reckless policy is annually involving him in a useless expense that could, in a large measure, be dispensed with if only a little more prudence and economy were exercised in dealing with his home manures. The probability is that fully one-half the amount that is now annually expended by every farmer who is compelled to buy artificial fertilizers, cauld be saved to him, or the money devoted to other purposes, if only he would proceed in an economical and intelligent manner to make use of all the waste products occurring about his farm for fertilizing purposes.

Improved Farming Operations Needed.

The time is ripe for improvement in many of the farming operations as practiced by even the most progressive of our Southern farmers. A new era must dawn before mother earth will consent to yield to the husbandman the rich store of harvest that she can so easily furnish if only a little inducement is offered her.

The writer will continue to press the importance of agricultural economy until it is apparent that the farmers of Florida are giving more attention to the matter, and until there dawns an era of agricultural prosperity in this state hitherto unknown, and which, in fact, is hardly possible under the present extravagant, careless and unscientific method that now characterizes most of our farming operations.

The table given below shows the average chemical composition of the most commonly occurring forms of animal manures about every farm premises. The figures used designate the per cent. of the several substances present.

NAME OF SUSBTANCE.	Per cent. of Phosphoric Acid.	Per cent. of Potash.	Per cent. of Nitrogen.
Cattle—solid, fresh excrement..	0.17	1.10	0.29
Cattle—fresh urine............	....	0.49	0.58
Hen manure—fresh...........	1.54	0.58	1.63
Horse—solid, fresh excrement..	0.17	0.35	0.44
Horse—fresh urine............	....	1.50	1.55
Human excrement—solid.......	1.09	0.25	1.00
Human urine.................	0.17	0.20	0.60
Pigeon manure—dry..........	1.90	1.00	3.20
Poudrette—night soil..........	1.40	0.30	0.80
Sheep—solid, fresh excrement..	0.31	0.15	0.55
Sheep—fresh urine............	0.02	2.26	1.95
Stable manure—mixed........	0.30	0.60	0.50
Swine—solid, fresh excrement...	0.41	0.13	0.60
Swine—fresh urine............	0.07	0.83	0.43
Tankage.....................	11.80	....	6.70

Commercial Fertilizers.

It is undoubtedly true that our modern system of cropping is removing plant food from the soil much more rapidly than it is being returned, or is capable of being returned by the application of all the available forms of home fertilizers from whatever sources. All the available supplies of barn-yard manure, hen droppings, muck or peat, and in fact every phase of material occurring about the farm premises, and which may be utilized in enriching the soil, cannot replenish the entire amount of plant nourishment that is withdrawn from a soil in the harvesting of crops. This, or these facts have led to searches for other sources, to the importation of various substances adapted to the purpose, and finally to the manufacture of what we, in later days, are accustomed to call "commercial fertilizers."

"There is as wide difference," says Mr. Greiner in his creditable little work on "Farm Chemistry," "between commercial fertilizers as there is between sand and manure, or between sugar and salt, or between a tender, juicy tenderloin steak and the sole of an old boot. Buying and applying concentrated fertilizers promiscuously, without having the least idea what they contain or what the soil needs, is little better than taking chances in a lottery."

"In compounding the various concentrated fertilizers, all sorts of materials are made use of—fish, bone, blood, slaughter house refuse, phosphate rock, guano, potash, salts, sulphate of ammonia, and many other things—and manufacturers are always on the lookout for everything available for this purpose, and purchasable at a reasonable price. As a result of all this, and of different ways of preparation, and different proportions in mixing, etc., we have the thousand and one different brands, in different degrees of strength and composition, for general and special purposes, and of different prices, from twenty dollars or less to forty-five dollars and upwards, per ton."

It is not the intention to attempt any extensive discussion of these several commercial fertilizing materials at this time, but after strongly warning the farmers of this State against the folly displayed in purchasing the so-called cheap fertilizers, especially if they have to be freighted for any distance, we shall simply mention the different kinds of materials that are the principal commercial sources of all the phosphoric acid, potash and nitrogen that are sold to the great farming classes throughout the entire country.

After doing this, a method for preparing a fertilizer mixture of any desirable strength will be given so that any farmer may, for himself, prepare at home, either out of home fertilizers or raw unmixed commercial products purchased in the markets, a special fertilizer of any character whatsoever, and adapted to the needs of any particular crop, or the requirements of any particular soil.

Finally, a number of formulas, especially prepared for the requirements of various crops, and which have been repeatedly tested with good results, will be given.

It is believed that a close study and observance of the directions prescribed, will prove of lasting benefit to the farmers by creating within them a spirit of economy in the use of fertilizing material, and afford them instruction in regard to the various requirements of different soils and crops.

The Composition of Various Commercial Fertilizing Material.

It might not be supposed, but nevertheless it is true, that there are a great many farmers in Florida who are not familiar with the fertilizing composition of the very commercial material that they are daily using for enriching their soil. For instance, many a man is accustomed to use cotton seed meal to increase the harvest on his land, and yet is unaware of the particular element of plant food that a dressing of it contributes. He simply knows that a soil may be in such a condition that by administering to it a treatment of cotton seed meal, its ability to produce crops will be increased. To know what element of fertility any particular substances possesses is, therefore, of the greatest importance. To illustrate: Suppose an acre of land has been continuously cultivated in tobacco, without receiving any fertilizer, until it ceases to produce a full crop, what would then be the plausable method for ascertaining the defect in said land? Why, undoubtedly, the sensible course of procedure would be to study the requiremeuts of tobacco in growing, (this should have been done prior to its cultivation), and in this way ascertain what element (or elements) is likely to have been most largely drawn upon and removed from the soil by repeated croppings. This knowledge will, in all likelihood, remedy the defect that has existed. It will doubtless be found that the tobacco soil (if previously it had possessed average fertility), had been partially or wholly exhausted of its store of potash sooner than of either of the other elements. Now, then, if this were the case, what kind of material should be added to make a soil to replenish its potash deficiency? Would cotton seed meal or dried blood be the proper kind of fertilizing substance to apply to it? To those who are familiar with the chemical composition of home and commercial fertilizers, this may appear to be a very useless question, but it is in order to say to them that while the query may seem unnecessary to them there are, nevertheless, a much larger number of farmers than they, themselves, are able to muster, who cannot answer it, and who need to know it.

We shall, therefore, proceed briefly to mention the different kinds of material that furnish a commercial source of the three valuable constituents of a commercial or artificial fertilizer, to-wit: Phosphoric acid, potash and nitrogen, beginning with that class of material which owes its ability to enrich a soil to its supply of

Phosphric Acid.

First under this head will be mentioned the various forms of naturally occurring phosphates, such as are found abundantly in Florida and South Carolina, and which are supposed to be the fossil remains of pre-historic marine animals. The second source of phosphoric acid to be mentioned is the bones of animals. If the bones have been ground into what is termed "bone meal" and have never been burnt, they will contain in addition to their store of phosphoric acid, a goodly store of nitrogen (about 4 per cent.), so that in fertilizing with this material both phosphoric acid and nitrogen are added to a soil. If the bone meal has been subjected to a steaming process, it will have only a little more than half the nitrogen that is contained in the raw bone meal mentioned above.

If the bones have been burnt until converted into ash, or bone black, (the spent residue from sugar refineries), then this ash will contain no nitrogen at all, but will owe its fertilizing value solely to its content of phosphoric acid (bone phosphate). The bones used for the manufacture of fertilizers come chiefly from slaughter houses, but are often picked up here and there. Fresh bone has nearly one-half of its weight of organic matter, (i. e., gelatine, water, etc.,) and one-half of its weight phosphate of lime, and nearly one half of the weight of the latter is phosphoric acid, and this, therefore, makes out something more than 20 per cent. of the fresh bone.

We see, therefore, that when we desire to buy bone meal for fertilizing purposes, it is very essential that we know whether we are buying the raw meal, the steamed meal or the bone ash.

When they are steamed before being ground nearly all the gelatine matter is extracted to make glue, and the larger portion of the nitrogen is thus abstracted. Now, in either of the above forms, we have the phosphoric acid in the form of simple bone phosphate, which is intermediate in solubility between the raw, pulverized phosphate rock and the same rock or bone after being acid treated. If it is desired to have the raw bone meal in a more immediately available form, it can be accomplished by treating the meal with a proper quantity of sulphuric acid. We will thus obtain what is called "dissolved bone," and as such, its store of phosphoric acid is immediately available. It is in this form that it exists in most of the so-called "high grade fertilizers." It should be stated that if the bone material be purchased in the form of bone ash (burnt bone), its store of phosphoric acid will be in a more soluble state than would be the case with that in the raw, or steamed bone meal, and it would not be necessary to subject it to sulphuric acid treatment to render its phosphoric acid available. Other sources, though not so common, for obtaining phosphoric acid, are guano and apatite. These sources are usually imported from foreign countries, chiefly from South America, but with the abundant supply of phosphate-containing material that occurs in various sections of our own country, I fail to see why it should be necessary for us to look to South America, or elsewhere, for a source of phosphoric acid.

Another commercial source of phosphoric acid, is a waste or by-product of iron industries, known as Thomas, or basic slag. It usually contains from 21 to 22 per cent. of phosphoric acid. Below will be found a table showing the average composition of various phosphate-containing material. The figures used denote the *per cent.* of phosphoric acid present in an average sample:

TABLE SHOWING THE PER CENT. OF TOTAL PHOSPHORIC ACID PRESENT IN VARIOUS KINDS OF MATERIAL.

	Total per cent. Phosphoric Acid
South Carolina Rock Phosphate (land)	27.0
South Carolina Rock Phosphate (river)	26.5
S. Carolina Rock (dissolved, i. e. acid phosphate)	15.20
Florida Rock Phosphate (land and River)	27.0
Florida Rock Phosphate (pebble, kiln dried)	27.0
Florida Rock Phosphate (hard rock)	34.5
Florida Rock Phosphate (soft rock)	31.0
Ground Bone (raw)	23.5
Ground Bone (steamed)	22.0
Bone Black (spent from sugar refineries)	33.5
Bone Black (spent from oil refineries)	27.5
Canadian Apatite	35.5
Phosphatic Guano	26.8

The substances enumerated in the above table constitute the chief commercial sources of phosphoric acid in all of our manufactured fertilizers, and when either of them is purchased and applied singly to a soil the principal constituent administered as nourishment is phosphoric acid.

Potash.

We come now to consider the chief commercial sources of potash. Among the substances that are to be mentioned in this connection are, first of all, the alkaline salts imported from Germany, to-wit: Muriate (chloride) of potash, sulphate of potash and kainit. There is at present only one mine known where these salts may be obtained, but the supply there is said to be inexhaustible. This whole mine is now the property of an English syndicate.

Muriate of potash usually contains from 50 to 55 per cent. of actual potash in an easily soluble form. For tree and small fruits this form of potash may be used with safety, but on account of the presence in it of a rather large amount of chlorine, it might do some damage when applied, even in moderate quantities, to some particular crops. With the information at present available, it would seem that, for orchard purposes and for general farm use, muriate is probably the cheapest commercial source of potash.

Sulphate of Potash.

Potash in the form of sulphate is one of the most superior sources of this element of plant food that is available. Sulphate of potash contains from 35 to 53 per cent. of pure potash, and its price varies from about $38 to $58 per ton. The high grade sulphate, containing on an average about 50 per cent. of pure potash, can usually be had for about sixty dollars per ton, and it is one of the very safest and most desirable forms of potash for all agricultural operations.

There is also a double salt of sulphate of potash and magnesia that has achieved considerable popularity. It contains about 26 per cent. of potash.

Kainit.

This substance, though it contains only a relatively small quantity of potash, (about 12 per cent.), is nevertheless a very prominent source of this element of plant food. The potash in kainit occurs partly as muriate and partly as sulphate of potash. It also contains chloride of sodium (common salt), sulphate of lime (gypsum), and chloride of magnesia. It has been found that kainit has the power of retaining or "fixing" ammonia to a very decided extent, so that it not only contributes to a soil its store of potash, but it also serves to retain ammonia which might be present in the soil in an easily volatile form, (i. e., carbonate of ammonia), and perhaps even draws it in from the atmosphere and retains it for the use of crops. On account of its large bulk, and its comparatively small per cent. of potash, it is hardly probable that it will prove a profitable investment for Florida farmers to purchase this substance where it will be necessary for them to pay for long freight hauls. Better buy the potash in the more concentrated forms of sulphate or muriate, thereby procuring more actual potash, with less bulk, and consequently, with smaller freight charges to pay.

Saltpetre.

Saltpetre (nitrate of potash), is, if pure, nearly one-half potash. This is the best and most expensive form because it is rich in two essential plant basis—potash and nitrogen. Owing to its comparative scarcity and high cost, it has no extensive use as a fertilizer in this country. It is probably worth about one hundred dollars per ton.

Domestic Sources of Potash.

The domestic or home sources of this material have already been referred to. The most important sources are saw palmetto ashes, (in Florida). The freshly dug root, after drying, yields an ash that contains about 43 per cent. of actual potash. Wood ashes, tobacco dust and stems, (these also contain nitrogen), cotton seed hull ashes, etc.

Below is given a table showing the average per cent. of potash present in each of the potash-containing substances which have been mentioned above:

	Per Cent. of True Potash.
Muriate of Potash contains	51.5
Sulphate of Potash (high grade)	50.0
Sulphate of Potash and Magnesia	26.0
Nitrate of Potash (also contains nitrogen)	45.20
Kainit	12.5
Saw-Palmetto Ash (freshly dug and burnt)	43.0
Wood Ashes (unleached)	5.25
Wood Ashes (leached)	1.27
Tobacco Stalks	5.02
Tobacco Stems	8.20
Corn Cob Ashes	23.20
Cotton Hull Ashes	22.75

The above constitute the principal available sources of potash for use in the manufacture of fertilizers.

Nitrogen.

Although vast and exhaustless stores of nitrogen in a free, or uncombined, state float as a component of the atmosphere over every acre of soil known to man—enough, indeed to furnish many hundred times as much plant food as all the crops of the globe could employ, still it is, nevertheless, far the most expensive of the three elements of plant nourishment that the farmer is called upon to purchase. This is due to the fact that, as yet, few processes are known by which the nitrogen of the atmosphere can be induced to enter into forms of combination that will carry it into the soil, there to serve as food for plants. It is known that nature does contribute a small amount of the atmosphere's vast nitrogen fund to the enrichent of the soil; and although the quantity thus contributed is probably too small to afford any perceptible effects on a growing crop, still it is altogether likely that enough is obtained in this way to slowly improve a piece of ground which is not under cultivation. The manner in which atmospheric nitrogen is thus contributed to a soil may be explained as follows: The ammonia escaping from the soil, and from various other sources in processes of decay, diffuses itself through the atmosphere; nitric acid is formed through the agency of the electricity which permeates the atmosphere during lightning flashes. The acid thus produced is absorbed by the rain and carried into the soil ready to be employed in the growth of vegetation.

Aside from this, the only atmospheric nitrogen which can be rendered available for such purposes is that which is drawn into the soil through the agency of certain little microscopic plants that infest the roots of that division of plants which are known as the Legumes, (i. e., peas, beans, clover, vetches, etc).

We see, therefore, that although nitrogen occurs in great abundance all around us, we are able to appropriate only the smallest amount of it to our agricultural needs, and must content ourselves, at present, with purchasing it at fully three times the cost that we are required to expend either for phosphoric acid or potash. With these observations, we are now prepared to study the kinds of material that are available for supplying the nitrogen that is constantly employed in the manufacture of fertilizers. And first in this connection, we will speak of

Nitrate of Soda.

In this substance we probably have the cheapest as well as one of the most valuable commercial sources of nitrogen. The greater quantity of this substance is imported to this country from Chili. Vast beds of it extend along the coast of South America for several hundred miles. There is an export duty on it of about ten dollars per ton, and but for this it would be much more extensively used in the United States. Comparatively little of this material is brought into this country, but Europe consumes annually upwards of a hundred thousands tons. In a chemically pure state, nitrate of soda would have 16.47 per cent. of nitrogen, but it takes a very pure sample of native nitrate to yield 16 per cent., or 320 lbs. of nitrogen per ton. It is claimed that on account of its color, nitrate of soda can very easily be adulterated, simply by mixing with it white sand, or some cheap form of potash salts; but it will be very easy for any one to detect such adulteration, simply by seeing if it will all dissolve in water. If it does not, then the insoluble portion will be either sand or some similar adulterant. Next taste the solution, and if it has no decided salty taste, it may be relied on that there is no cheap form of potash salt present.

The great advantage that nitrate of soda possesses over many other forms of nitrogen-containing material is that its nitrogen is very readily available, while that in farm manures, etc., and various other sources is only slowly available. It may be remembered that the nitrate forms are always those which can be relied upon to yield up their store of nourishment to crops with little if any delay.

Nitrate of Potash, (Saltpetre.)

This substance has already been spoken of as a commercial source of potash, but it is well to remember that it owes its excellent merits as fertilizer to its content of nitrogen as well as its potash. It contains, on an average, about 13 per cent. of nitrogen. Like nitrate of soda this salt is imported from South America. Its application to a soil often produces more marked and speedy effects than results from an application of nitrate of soda, but, as has been already stated, it is too expensive to be used in a general system of cropping.

Sulphate of Ammonia.

Sulphate of ammonia, though only a by-product of the gas works, is, nevertheless, a very valuable commercial source of nitrogen. In appearance it very closely resembles fine salt, but it does not absorb moisture so rapidly, nor does it, as a rule, form itself into hard, solid chunks like nitrate of soda. Because of these facts, it is much easier and more convenient to handle, and to mix with other substances in preparing a uniform fertilizing mixture. It contains, on an average, about 20 per cent. of nitrogen, and many claim that it gives about as good results as nitrate of soda. Experience has demonstrated that its nitrogen is not so immediately available as that in nitrate of soda, but this would really seem to be an advantage, because its nitrogen, which is not immediately available, will be retained in the soil to be used at some later day when plants will be sure to demand it, whereas, in the case of nitrate of soda, where all the nitrogen is readily available, such as might not be used by growing plants at the time, is likely to be dissolved by rains and washed down into the soil out of the reach of plant roots. It is but fair to say, however, that it is customary these days not to apply all of the nitrate of soda to a soil at one time, but to sprinkle it on at intervals, whenever the appearance of vegetation indicates that another dressing will prove beneficial.

Other Commercial Sources of Nitrogen.

Other commercial sources of nitrogen which may be mentioned, are: Cotton seed and cotton seed meal, linseed meal, castor pomace, dried blood, fish scrap, dried flesh, tankage, tobacco stems, etc., all of which possess good fertilizing merits; and other material, such as horns, hoofs, wood-waste, etc., are also comparatively rich in nitrogen, but on account of the fact that their nitrogen is much less readily available they cannot be commended along with that class of material previously mentioned.

Below is given a table showing the *per cent.* of nitrogen occurring on an average in each of the substances which have been discussed:

	Per Cent of Nitrogen.
Nitrate of Soda	15.75
Nitrate of Potash	13.09
Sulphate of Ammonia	20.50
Cotton Seed Meal	6.66
Linseed Meal	5.78
Castor Pomace	5.56
Dried Blood	10.52
Dried Fish	7.25
Tankage	6.82
Tobacco Stems	2.29
Horn and Hoof Waste	13.25
Wool Waste	5.64
MISCELLANEOUS PRODUCTS.	
Gas Lime	0.30
Muck (fresh)	0.30
Muck (air dry)	1.30
Mud (fresh water)	1.37
Mud (from sea meadows)	0.20
Peat	0.75
Pine Straw (dead leaves or needles)	0.30
Shells (crustacea)	6.20
Scum (sugar house)	2.10

What the Tables of Analyses Teach.

With what has been said it ought to be an easy matter for every farmer who studies these pages closely to understand the real fertilizing value of any substaance incorporated in either of the foregoing tables. Such knowledge ought to enable him better to understand how to proceed to fertilize his soil, using only such material for the purpose as will be sure to subserve the desired ends. When phosphoric acid is what is needed, then any material enumerated in the foregoing list of phosphatic manures may be counted on to supply the deficiency, and the same may be said in regard to potash and nitrogen. Where one substance contains an appreciable quantity of both potash and nitrogen (such, for instance, as nitrate of potash and tobacco stems), the fact has been referred to.

How to Employ Raw Material

in compounding fertilizers for all general and special agricultural requirements. Having explained fully the several points to be considered in using fertilizers, and the various sources whence each element of plant food used in the preparation of the same may be obtained, it is now in order to explain how to make use of such information, and how to employ the analyses of the various substances quoted, in making up definite quantities of both general and special mixtures of any desired strength, to subserve in any and all requirements.

Let us suppose that we desire to make up a ton (2,000 lbs.) of fertilizer mixture which shall analyze:

Phosphoric acid	8.00 per cent.
Potash	12.00 per cent.
Nitrogen	8.00 per cent.

The following material, with the chemical analysis of each substance, is at hand to be used in compounding the desired mixture: Acid phosphate, 20 per cent. (i. e. containing 20 per cent. phosphoric acid); muriate of potash, 50 per cent. (i. e. containing 50 per cent. potash); nitrate soda, 16 per cent. (i. e. containing 16 per cent. nitrogen). Now the proportion is this: How much of these several substances will it be necessary to use in preparing a fertilizer that shall have, per ton, the proportions of the several fertilizing ingredients specified above?

To begin with, it is manifest that if the ton of compounded fertilizer is to contain 8 per cent. of phosphoric acid, it must contain exactly 160 lbs. of true phosphoric acid (2,000 x .08 = 160 lbs.), because 8 per cent. of 2,000 lbs. is 160 lbs. And if the said fertilizer is to contain 12 per cent. of potash per ton it must have exactly 240 lbs. of actual potash for the same reason (2,000 x .12 = 240 lbs), and similarly, if the prepared fertilizer is to contain 8 per cent. of nitrogen, it must have 160 lbs. of true nitrogen (2,000 x .08 = 160 lbs.).

Now, then, the next question that presents itself is, how much of these several raw materials will it be necessary to use in order to obtain the required amounts of phosphoric acid, potash and nitrogen.

Reverting to the raw materials and their analyses, we see that the acid phosphate which is to furnish the necessary phosphoric acid is guaranteed to contain 20 per cent. of phosphoric acid. Now, how much, or how many hundred pounds of this material will it be necessary to use to supply the required amount of phosphoric acid? (i. e., 160 lbs. per ton of mixture).

To ascertain this, we reason as follows: If 100 lbs. of the acid phosphate contains 20 lbs. of phosphoric acid (which is guaranteed), then it will take as many hundred lbs. of acid phosphate to provide 160 lbs. of phosphoric acid as 20 is contained times into 160, or, in other words, 800 lbs. of acid phosphate will be required.

And pursuing exactly the same line of reason, it will be found that 480 lbs. of muriate of potash, of the guaranteed strength (50 per cent.) will be required to furnish the required amount of potash (i. e. 240 lbs.)

And similarly, 1,000 lbs. of nitrate of soda (analyzing 16 per cent. of nitrogen), will be needed to furnish the necessary amount of nitrogen (140 lbs.)

Summarizing, we find that we have employed

800 lbs. of acid phosphate,
480 lbs. of muriate potash, and
1,000 lbs. of nitrate of soda, or

2,280 lbs. of total raw material.

This mixture, when thoroughly mixed, should analyze:

Phosphoric acid,	8.00 per cent.
Potash,	12.000 per cent.
Nitrogen,	8.00 per cent.

and these were the proportions of the several fertilizing constituents required. But our proposition was to make up exactly one ton (2,000 lbs.) of this mixture, whereas we have on hand 2,280 lbs. of mixed material. Therefore, to make up exactly one ton, or 2,000 lbs., we must resort to still further figuring.

We next ask ourselves what proportion of the entire mixture (2,280 lbs.) is acid phosphate, what proportion is muriate potash, and what nitrate of soda? To answer this, we look back and find that 800 lbs of acid phosphate were used. Therefore, the proportion of acid phosphate to the entire mixture is as 840 is to 2,280, or expressed in simpler language, the acid phosphate is $\frac{800}{2280}$ of the entire mixture. And similarly, the proportion of muriate of potash will be found to be $\frac{480}{2280}$ of the total mixture, and the proportion of nitrate of soda will be $\frac{1000}{2280}$ of the whole amount. We have, therefore, in the mixture the following proportions of the several substances:

$\frac{800}{2280}$ acid phosphate,
$\frac{480}{2280}$ muriate potash,
$\frac{1000}{2280}$ nitrate of soda.

After obtaining these figures, it is an easy matter, then, to make up any definite quantity of mixture of a specified strength. For instance, to make up exactly one ton (2,000 lbs.) the proportion would be:

$\frac{800}{2280}$ x 2,000 (= 701.75 + lbs.) of acid phosphate.
$\frac{480}{2280}$ x 2,000 (= 421.05 + lbs.) muriate potash.
$\frac{1000}{2280}$ x 2,000 (= 877.19 + lbs.) nitrate soda.

Adding these, we have:

701.75 + lbs. acid phosphate.
421.05 lbs. muriate potash.
877.19 + lbs. nitrate soda, or

1999.99 lbs. of total mixture, which is as near as one could well come to the absolutely correct amount of the several quantities in practice. This method will hold good in preparing a fertilizer of a required strength from any kind of raw material whatsoever. It is commended to the careful study of every farmer in Florida. It should be filed carefully and referred to whenever it is desired by any farmer to prepare a special home fertilizer for a particular purpose out of any of the various products whose analyses have been given in the preceding pages.

Of course, after obtaining the requisite amount of material for mixing in one ton, it will be very easy to make up five or ten, or twenty tons of the same grade mixture simply by using five or ten, or twenty times the amount of the different substances it was found necessary to employ in preparing one ton of the mixture. In conclusion, it is necessary to remind all that it will require constant and repeated stirring of the different raw materials before a uniform mixture will be obtained.. Too much stress cannot be laid upon this point, otherwise no uniform results, in the way of yield of crops need be expected, when it is applied to a soil.

Appendix.

On the following pages is given a tabulated table, compiled by Prof. Frank W. Sempers for his admirable little work on Manures, and showing the proportions of nitrogen, phosphoric acid and potash which ought to be present in a fertilizer in order to best adapt it to growing various kinds of crops. The figures used are accurate and may be relied upon, for they are all the results of scientific investigations, which have been carried on at the various Experiment Stations throughout the United States, and elsewhere. The tables also show the kinds of material best suited to furnishing the supplies of nitrogen, phosphoric acid and potash for different crops, and the quantity of the fertilizer mixture, per acre, that it will be found best to apply. Where the quantity of the latter varies from 500 to 1,000 lbs. per acre, etc., of course the different amounts recommended have reference to the original fertility of the land which is to receive them. If the soil is already one of average fertility, then 500 lbs. of the mixture will be deemed a sufficient application, but if the soil is known to be deficient in the essential elements of plant food, then larger quantities of the fertilizers should be applied; in a very poor soil, the largest figures recommended should be used.

Proportions of Nitrogen, Phosphoric Acid and Potash, and Quantities of Fertilizer, Per Acre, Recommended for Crops.

[Note.—Unleached wood ashes and high-grade sulphate of potash are always intended when used in these tables.]

CROP.	PER CENT OF			Pounds Per Acre.	BEST FORM FOR CROP. [When different forms for applying are given, either will do.]		
	Nitrogen.	Available Phosphoric Acid	Potash.				
Asparagus	4 to 5	6 to 7	7 to 9	400 to 800	Nitrate of Soda. Dried Blood. Dissolved Bone Meal.	Dissolved Bone Black. Basic Slag Phosphate. Dissolved Florida Rock.	Wood Ashes. Kainit.
Barley	5 to 6	7 to 8	3 to 5	250 to 600	Nitrate of Soda. Sulphate of Ammonia.	Dissolved Bone Black. Dissolved Florida Rock	Wood Ashes. Muriate of Potash.
Beans	1 to 2	6 to 8	7 to 9	400 to 800	Nitrate of Soda. Sulphate of Ammonia. Dried Blood.	Dissolved Bone Black. Dissolved Florida Rock	Wood Ashes. Muriate of Potash.
Beets—Mangels	5 to 6	5 to 6	7 to 9	400 to 800	Nitrate of Soda.	Dissolved Bone Black. Dissolved Florida Rock	Sulphate of Potash.
Blackberries	2 to 3	5 to 6	7 to 9	500 to 800	Nitrate of Soda. Raw Bone Meal.	Dissolved Bone Black. Raw Bone Meal.	Wood Ashes. Kainit.
Buckwheat	4 to 4½	7 to 8	9 to 10	400 to 800	Nitrate of Soda.	Dissolved Florida Rock. Basic Slag Phosphate.	Muriate of Potash.

Cabbage	5 to 6	5 to 6	7 to 9	800 to 2000	In the three forms of Nitric Acid, Ammonia and Organic Nitrogen.	Dissolved Bone Black. Dissolved Florida Rock	Wood Ashes. Muriate of Potash.
Cauliflower	4 to 5	5 to 7	7 to 9	900 to 1800	In the three forms of Nitric Acid, Ammonia and Organic Nitrogen.	Dissolved Bone Black. Dissolved Florida Rock	Wood Ashes. Muriate of Potash.
Bananas	4 to 5	6 to 8	7 to 9	500 to 800	Nitrate soda. Cotton Seed Meal.	Dissolved Florida Rock Dissolved Bone Meal.	Sulphate of Potash. Kainit.
Castor Oil Plant	6 to 8	6 to 8	3 to 5	400 to 600	Nitrate Soda. Sulphate Ammonia.	Dissolved Florida Rock Dissolved Bone Meal.	Muriate of Potash. Kainit.
Celery	5 to 6	5 to 6	8 to 10	1000 to 1500	In the three forms of Nitric Acid, Ammonia and Organic Nitrogen.	Dissolved Florida Rock Dissolved Bone Meal.	Wood Ashes. Muriate of Potash.
Clover and Legumens	1 to 2	6 to 8	8 to 10	400 to 800	Sulphate of Ammonia. Dried Blood.	Dissolved Florida Rock Dissolved Bone Meal.	Wood Ashes. Muriate of Potash.
Corn	2 to 3	7 to 8	6 to 7	500 to 1000	Nitrate Soda. Organic Nitrogen.	Dissolved Florida Rock Dissolved Bone Meal.	Wood Ashes. Muriate of Potash.
Cotton	2 to 3	7 to 9	4 to 5	300 to 400	Nitrate Soda. Cotton Seed Meal.	Dissolved Florida Rock Dissolved Bone Meal.	Cotton Seed Hull Ashes. Wood Ashes. Kainit.
Cucumber	4½ to 5	5 to 6	6 to 8	1000 to 1500	In the three forms of Nitric Acid, Ammonia and Organic Nitrogen.	Dissolved Bone Black. Dissolved Florida Rock	Wood Ashes. Muriate Potash.
Fruit Trees	1½ to 2	7 to 9	10 to 12	400 to 700	Nitrate Soda. Raw Bone Meal.	Dissolved Bone Black. Dissolved Bone Meal. Dissolved Florida Rock.	Wood Ashes. Muriate Potash. Kainit.
Grape Vines	1½ to 2	7 to 9	10 to 12	500 to 700	Nitrate Soda. Raw Bone Meal.	Dissolved Bone Black. Dissolved Bone Meal. Dissolved Florida Rock.	Wood Ashes. Muriate Potash. Kainit.

Proportions of Nitrogen, Phosphoric Acid and Potash, and Quantities of Fertilizer, Per Acre, Recommended for Crops.

[NOTE.—Unleached wood ashes and high-grade sulphate of potash are always intended when used in these tables.]

CROP.	PER CENT. OF			POUNDS PER ACRE.	BEST FORM FOR CROP. [When different forms for applying are given, either will do.]		
	NITROGEN.	AVAILABLE PHOSPHORIC ACID	POTASH.				
Grass	5 to 6	5 to 6	7 to 8	400 to 800	Nitrate Soda. Dried Blood. Raw Bone Meal.	Raw Bone Meal. Basic Slag Phosphate. Dissolved Florida Rock.	Wood Ashes. Kainit.
Hops	2½ to 3½	5 to 6	12 to 14	800 to 1200	Nitrate Soda. Organic Nitrogen.	Dissolved Bone Black. Dissolved Bone Meal. Dissolved Florida Rock.	Wood Ashes. Muriate Potash.
Lettuce	5 to 6	5 to 6	8 to 10	900 to 1500	In the three forms of Nitric Acid, Ammonia and Organic Nitrogen.	Dissolved Bone Meal. Dissolved Bone Black. Dissolved Florida Rock.	Wood Ashes. Muriate Potash.
Melons	5 to 6	5 to 6	7 to 9	500 to 1500	Nitrate Soda. Dissolved Bone Meal	Dissolved Bone Meal. Dissolved Bone Black. Dissolved Florida Rock.	Wood Ashes. Muriate Potash.
Oats	4 to 5	5 to 6	8 to 10	300 to 600	Nitrate Soda. Dissolved Bone Meal	Dissolved Florida Rock Basic Slag Phosphate.	Wood Ashes. Muriate Potash.
Olives	4 to 5	5 to 7	7 to 8	500 to 700	Nitrate Soda. Sulphate Ammonia.	Dis. Florida Phosphate. Dissolved Bone Black.	Muriate Potash. Kainit.

Onions	5 to 6	5 to 6	8 to 10	900 to 1800	Nitrate Soda.	Dissolved Bone Black. Dissolved Florida Rock	Wood Ashes. Muriate Potash.
Oranges and Lemons	4 to 6	6 to 8	8 to 10	....	Nitrate Soda. Sulphate Ammonia.	Dis. Florida Phosphate. Dissolved Bone Black.	Sulphate Potash. Muriate Potash. Kainit.
Peanuts	....	6 to 7	7 to 8	500 to 800	....	Dissolved Florida Rock Dissolved Bone Black.	Muriate Potash. Kainit.
Peas	1½ to 2	7 to 9	7 to 9	400 to 800	Nitrate Soda. Sulphate Ammonia.	Dissolved Bone Black. Dissolved Florida Rock	Muriate Potash. Kainit.
Pineapples	Each plant is manured with a mixture of one part of sulphate of potash and three parts of Peruvian Guano; or, one part phosphate potash and one part of phosphate of ammonia.						
Potatoes	4 to 6	5 to 7	7 to 9	500 to 1500	Nitrate Soda. Dried Blood.	Dissolved Bone Black. Dissolved Florida Rock	Sulphate of Potash.
Pumpkins	5 to 6	5 to 6	8 to 9	600 to 1000	Nitrate Soda.	Dissolved Bone Black. Dissolved Florida Rock	Wood Ashes. Muriate Potash.
Raspberries	2½ to 3	5 to 7	8 to 10	500 to 1000	Raw Bone Meal. Nitrate Soda.	Dissolved Bone Meal. Dissolved Bone Black. Dissolved Florida Rock.	Wood Ashes. Kainit.
Rice (water)	2 to 3	8 to 10	3 to 4	500 to 600	Ground Bone.	Thomas Slag. Ground Bone.	Muriate Potash. Kainit.
Rice (mountain)	2 to 3	6 to 7	6 to 8	600 to 700	Nitrate Soda.	Dissolved Florida Rock. Thomas Slag. Dissolved Bone Black.	Muriate Potash. Kainit.
Rye	4 to 5	5 to 7	8 to 10	300 to 600	Nitrate Soda.	Dissolved Florida Rock. Thomas Slag. Dissolved Bone Black.	Wood Ashes. Muriate Potash.

Proportions of Nitrogen, Phosphoric Acid and Potash, and Quantities of Fertilizer, Per Acre, Recommended for Crops.

[NOTE.—Unleached wood arhes and high-grade sulphate of potash are always intended when used in these tables.]

CROP.	PER CENT. OF			POUNDS PER ACRE.	BEST FORM FOR CROP. [When different forms for applying are given, either will do.]		
	NITROGEN.	AVAILABLE PHOSPHORIC ACID	POTASH.				
Squash	5 to 6	5 to 6	7 to 9	500 to 1500	Nitrate Soda.	Dissolved Florida Rock. Thomas Slag. Dissolved Bone Black.	Wood Ashes. Muriate Potash.
Strawberries	2½ to 3	5 to 7	7 to 9	500 to 1500	Nitrate Soda. Raw Bone Meal.	Dissolved Bone Black. Raw Bone Meal. Dissolved Florida Rock.	Wood Ashes. Kainit.
Sorghum (for sugar)	3½ to 4½	8 to 9	8 to 9	400 to 500	Nitrate Soda.	Dissolved Florida Rock.	Sulphate Potash. Kainit.
Sorghum (for forage)	3½ to 4½	5½ to 6½	4 to 5	650 to 750	Nitrate Soda.	Dissolved Florida Rock.	Muriate Potash. Kainit.
Sugar cane	1½ to 2	7 to 9	7 to 9	600 to 900	Nitrate Soda. Cotton Seed Meal.	Dissolved Florida Rock Dissolved Bone Black.	Muriate Potash. Kainit.
Tobacco	5 to 7	5 to 6	8 to 11	1000 to 2000	Nitrate Soda.	Dissolved bone Black.	Cotton Seed Hull Ashes. Wood Ashes. Sulphate Potash.

Tomatoes	4 to 6	5 to 6	6 to 8	500 to 1000	Nitrate Soda. Dried Blood.	Dissolved Bone Black. Dissolved Florida Rock	Wood Ashes. Muriate Potash.
Turnips (Ruta Baga)....	4 to 5	6 to 7	7 to 9	300 to 500	Nitrate Soda. Dissolved Bone Meal	Dissolved Bone Meal. Dissolved Bone Black. Dissolved Florida Rock.	Wood Ashes. Muriate Potash.
Wheat	4 to 5	6 to 8	3 to 4	300 to 600	Nitrate Soda. Sulphate Ammonia. Dried Blood.	Dissolved Bone Black. Thomas Slag. Dissolved Florida Rock.	Muriate Potash.

NOTE:—The above formulas have been chiefly taken from Prof. Sempers' Treatise on Manures, but frequent deviations have been made in order better to adapt them to Florida.

Fertilizers for a number of crops grown in this State, which Prof. Sempers' little work failed to mention, have been inserted.

[illegible] 64

A CORRECTION IN BULLETIN NO. 22

—OF THE—

Florida ✦ Experiment ✦ Station

PAGES 38 TO 40 INCLUSIVE.

In Bulletin No. 22, of this Station, there appears an error in calculation which, though so apparent as to be easily detected by any one at all accustomed to mixing fertilizers, nevertheless, would seem to admit of correction in this form. It is the desire of the Station authorities to provide the farmers only with the most trustworthy and accurate information, and while, as stated above, the error which is herein noted is so plain that it would not be likely to deceive and thereby work injury to any one, still the writer deems it his duty to call attention to the error in the aforesaid calculation.

In answer to an urgent summons, it was necessary for the author of the Bulletin to leave the Station very suddenly for an extended absence, just as the closing pages of the publication were being prepared and only a few moments were available for jotting down the calculation in question. He had no opportunity for revising the proof sheets, and hence the error escaped de- ion until the Bulletin made its appearance.

The necessity for this correction is deeply regretted, but the writer is im- ed to this step in justice to the many readers of the Station publications, vell as to himself. In conclusion, the author of the Bulletin in question, ires to express his thanks to the agricultural public for the very generous eption that has been accorded the publication. It will be well for every who has been the recipient of Bulletin 22, to insert this correction at o 28.

Very Respectfully,
A. A. PERSONS,
CHEMIST

How to Employ Raw Material in Mixing Fertilizers Of a Specific Strength.

In preparing a quantity of a fertilizer of any required strength, care must be exercised in purchasing the raw material for mixing, to see that the material purchased is sufficiently concentrated (i. e., is rich enough in the element of plant food which it contains) to provide the definite quantity of mixed fertilizers sought. That is to say, if it is desired to compound exactly one ton (2000 lbs.) of a complete fertilizer mixture that will analyze, say:

Phosphoric acid . .	8.00 per cent.
Potash	12.00 per cent.
Nitrogen	8.00 per cent.

then, it will be necessary to use a very concentrated form of material for supplying each constituent of plant food, so that in providing the ton of mixed material with the requisite quantities of the several plant food constituents (to-wit: Phosphoric acid, Potash and Nitrogen), the quantity of raw material used must not aggregate more than 2000 lbs. otherwise, the fertilizer mixture would not be of the strength desired, but might be considerably less—depending, of course, upon the strength, or degree of concentration, of the several sources of plant food.

Let us suppose that we have on hand:

Acid phosphate containing 20% Phos. acid;
Muriate Potash containing 12% Potash;
Nitrate Soda containing 16% Nitrogen;

and we desire to employ this raw material in preparing a ton (2000 lbs.) of fertilizer mixture which will analyze:

8.00 per cent Phosphoric acid
12.00 per cent Potash
8.00 per cent Nitrogen.

The first question we would ask ourselves would be: "How many pounds of Phosphoric acid, must the ton of fertilizer contain, if it is to analyze 8.00 per cent. of this substance? The answer to this would be 160 lbs. (2000 x.08 = 160 lbs.) A similar query in regard to the number of pounds of Potash and Nitrogen that the ton of mixture would contain, would reveal the fact that 240 lbs. of the former and 160 lbs of the latter must be present in every ton of mixture, in order that the prepared fertilizer may be of the desired strength.

Having gained this information, the next question to be asked is: How much acid phosphate of the strength desi-

Bulletin No. 23. **December, 1893.**

FLORIDA
AGRICULTURAL EXPERIMENT
STATION.

INSECTICIDES AND FUNGICIDES.

P. H. ROLFS.

The Bulletin of this Station will be sent free to any address in Florida
upon application to the Director of the Experiment
Station, Lake City, Fla.

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INSECTICIDES AND FUNGICIDES.

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INTRODUCTION.

Spraying of fruit trees and other plants to prevent injury from insects and fungi is of comparatively recent origin.

The first systematic work performed in that line in this country was that against the Colorado potato beetle. In the Report of the Department of Agriculture for 1871 we find Paris green recommended for the first time. After that several agricultural colleges took up the work systematically, but it was several years before any work was done with a view to prevent diseases caused by fungi.

This new department in agriculture demands terms that shall be used exclusively for it; this bulletin contains as few of these newly introduced terms as seemed consistent. The term *insect* is generally understood to include all the smaller animals that have their bodies divided into three regions; their young are called grubs, maggots, caterpillars, and some have special names, as cut-worms, wire-worms, etc. The ending *cide* means to kill, hence an *insecticide* is any substance that is used to *kill insects.*

INSECTICIDES FOR BITING INSECTS.

Insects, like higher animals, require food and air for their existence, and to poison the food or cut off their supply of air will kill them as surely as it will kill any higher animal. The earliest way of combating insects was, as stated before, by poisoning their food; this was accomplished by the use of Paris green. All the insects that ate enough of the Paris green died, but those that ate from the portions of plants not covered with poison were not harmed; hence the more thoroughly a plant is sprayed the greater the number of insects that will be killed, but here another difficulty is encountered; if more than a certain amount of poison is used the plant will be killed also.

INSECTICIDES FOR SUCKING INSECTS.

While some insects obtain their food by eating the leaves and outer portion of plants generally, others get their nourishment by sucking the juices from the plants; now it is clear that these cannot be poisoned except by poisoning the juice of the plant, and that so far has been impracticable. To this class of insects belong the plant-lice, the scale-insects, plant-bugs and others. These stick their proboscis into the bark or the leaf, and take out the nourishment they want. It has been found that these may be killed by cutting off their supply of air, or by rendering the air they breath poisonous. By studying the anatomy of insects it was found that they do not breathe through their mouths as the back-boned animals do, but they take in the air through a system of openings on each side of the body. These openings are called *tracheæ* and are normally eleven on a side. Any substance that might be brought in contact with an insect and that would close up the tracheæ, would suffocate it. Water will not do this because the insects are more or less oily and the minute hairs help to hold air to their bodies and prevent water from entering the tracheæ. Some oily or soapy substance may be used to effect an entrance. We have remedies of this kind in our resin soaps, kerosene emulsions, and a number of others.

Another mode of killing insects that do not eat the epidermis of plants has already been referred to. It is by poisoning the air they breathe. This is accomplished by the gas treatment, sulphur spray and carbon disulphide.

Experience alone can teach us as to which insecticide is best for any particular case. Often a substance that will kill a particular pest will also kill the tree or plant it affects. Nearly all insecticides need to be used with care, and substances that have been advertised as "perfectly harmless," are found to be indeed so to insects.

WHAT FUNGI ARE.

Many diseases of plants as rusts, rot, mildews and some blights are caused by a class of minute plants called fungi. Commonly these are not recognized as plants, because we usually associate chlorophyl, the green coloring matter, with plants, but a close study reveals that we may have plants without this chlorophyl. Plants without chlorophyl cannot take up material directly from the earth, inorganic matter, and convert it into plant material, organic matter, but they must rely upon the plants with chlorophyl to elaborate this (organic) material for them. Fungi are not supplied with chlorophyl, hence they must rely for sustenance upon plants with it, either by living directly on living ones or on dead ones; to this latter belong mushrooms, toad-stools and shelf fungi. The former, that live upon living plants and cause diseases, concern us directly.

PARASITIC FUNGI.

These parasitic fungi, that is, those that live on living plants, are usually very minute and of a simple structure, often being composed of a simple thread-like body, only a fraction of an inch long, but when there are myriads of them present on a single leaf or fruit, the damage is soon visible. The damage to the host, the plant the parasite lives on, is often very great before the true cause is recognized; the food being diverted from its proper course makes the host less fruitful, and often fruitless, without any apparent cause.

Fungi do not develop flowers or seed, but they produce what are called spores. These spores perform some of the functions of seed. In many cases a spore is so light that it may be carried long distances by the wind; it will also withstand long droughts and severe cold; again, if the proper temperature and moisture are present it will often germinate very quickly. When a spore finds lodgment on the leaf, stem or fruit of its host it germinates and the parasite enters the tissues where it draws nourishment from the host. Moisture is quite an aid in the development of fungoid diseases; warm, moist days and nights are especially favorable. Dashing rains wash off the spores and in that way are beneficial, but the heavy dews that usually follow rains bring about conditions favorable to propagation of fungi. Dry and cold weather is unfavorable to germination and propagation of fungoid diseases. When fungi have entered their host they cannot be killed without damaging the tissue of their host. The object, then, is to destroy these disease-producing fungi before they enter their hosts.

Plants are more or less susceptible to poisoning from copper compounds. Some plants are much more sensitive than others in this respect; for example, a compound that did not hurt tomato vines, scalded eggplant badly. When in condition for entering their hosts fungi are very sensitive to poisoning from copper compounds. So the experimenters have found such compounds as will kill the attacking fungus and not injure the host.

WHAT IS A FUNGICIDE?

A serviceable fungicide is something that will destroy a fungus it comes in contact with, and not the host of that fungus. The word is made up *fungi*, dicussed above, and *cide*, to kill. The several copper preparations given are such substances. The fungus must first come in contact with the host before it can cause disorder of the host, now if it comes in contact with the host and not with the fungicide, it forces an entrance and causes disease of the plant; but if the host has been covered with the fungicide, the fungus coming in contact with the fungicide, will be killed and the disease prevented. To make a plant immune to disease it is necessary to cover the entire plant with a fungicide. This is not possible. As a rule the more thoroughly the host can be covered with the fungicide the more thorough will the protection be.

WHEN TO SPRAY.

As spraying is only a preventive for disease of plants, the time to spray becomes of prime importance. It is necessary to anticipate these disorders and prevent their attacking the plant.

In fields where the crop has suffered in a previous year it is quite certain that the same crop will suffer from the same disease the following year, and the treatment, to be most effective, should be begun before the appearance of diseased plants. The treatment for black rot of grapes should be begun before the buds open in the spring, for blight of tomatoes and egg plant before the flower buds open.

The interval between sprayings should be a week or ten days. When heavy rains occur they wash the fungicide off, and the operations must be repeated at shorter intervals than during dry weather.

Grapes should be sprayed four times; potatoes six times, and tomatoes and egg plants as long as the yield of fruit is profitable.

No certain rule as to date can be laid down; each person must be guided, to a large extent, by the conditions that surround his crop, also by the crop that is to be treated.

HOW TO SPRAY.

In general it may be laid down, as a rule, that the leaves and branches should be thoroughly covered with the fungicide. The more thoroughly this is done and the shorter the interval between sprayings, the more effective will be the work. There is one exception to this, however, that is the tomato blight. This disease is not checked by spraying the *foliage* of plants, but by spraying the parts of the plants that touch the ground and the ground about the plant. (See Bulletin 21, Florida Agricultural Experimental Station, page 32. For plants affected see pages 25–31).

FUNGICIDES.

A great many different formulas for fungicides have been tried but only a few of these have become popular. Those mentioned here have been deemed of most importance to the farmers and fruit growers of our State. The formulas and methods of preparation are given on the following pages:

BORDEAUX MIXTURE.

The formulas used in its preparation are almost as numerous as the experimenters that have tested it. One that has been generally used with excellent results is as follows:

Formula No. 1.

Copper Sulphate, (blue stone, blue vitrol) . .	6 pounds
Lime, fresh	4 "
Water	22 gallons

Another formula is one of just half the strength of the above; that is, to use forty-four gallons of water in place of twenty-two, or use:

Formula No. 2.

Copper Sulphate	3 pounds
Lime	2 "
Water	22 gallons

HOW TO PREPARE COPPER SULPHATE.

It is best to use the pulverized copper sulphate, when this can be obtained. Dissolve six pounds in three gallons of hot water, if the first formula is to be followed. If the second, dissolve three pounds of copper sulphate in two gallons of water; add enough water to make sixteen gallons. If pulverized copper sulphate cannot be had, put six or three (according to the formula to be followed) pounds of it in a feed bag; then put sixteen gallons of water in a barrel and suspend the bag containing the copper sulphate just under the water. In this way the crystals will dissolve in a few hours; if they are thrown into the water they will not dissolve for a long time.

When a considerable amount of Bordeaux mixture is to be made forty-eight gallons of water may be placed in a barrel and forty-eight pounds of copper sulphate suspended as described above. In this case it would be well to put the sulphate in several bags, as it would then dissolve more quickly. Six gallons of this should be taken out and diluted to sixteen for the first formula, and three taken out and diluted to sixteen for the second formula. In either case all the copper sulphate in the bags should be dissolved and the solution stirred before taking out the stock solution.

Never use any iron or tin vessel to handle or to hold the copper sulphate solution; use wooden or earthen ones. Strain the solution and be sure that the vessel and the water are also free from solid particles; they clog the machines and cause a great deal of annoyance.

HOW TO PREPARE LIME.

Fresh, or quick lime, should be used. When the lime slakes in the air, or becomes air-slaked, it undergoes a chemical change and hence does not make Bordeaux mixture when used in place of quick lime. Place the quick lime in an earthen or a wooden vessel, pour on enough water to cover it well; soon it will begin to simmer and become hot. During this time it must be carefully watched and well stirred. If it uses up all the water add more. When it is slaked it should be a thick paste. Now add enough water to make six gallons. (It is understood, of course, that if the Bordeaux is to be made by the first formula that four pounds of lime have been used, and if by the second, two). Stir the solution thoroughly, then let it stand a short time for any solid particles that may be in it to settle, and it is ready to be poured into a copper sulphate solution.

HOW TO MIX BORDEAUX.

The copper sulphate solution and the lime solution, each being prepared as described above, pour the lime solution slowly into the copper sulphate solution, taking special care not to get any solid particles into the mixture; stir it briskly and thoroughly and apply at once. The mixture is at its best just after it is made, and becomes less valuable by standing.*† After standing a day or two it is probably not worth the while to apply it.

It is very difficult to strain this mixture, hence the precautions taken to free the solution of all matter that would clog the spraying machine. After the mixture has stood an hour or more the precipitate begins to settle, leaving a clear liquid above. If one is obliged to allow the precipitate to settle, care should be taken to stir it again and make the mixture as even as possible.

Machines are now made with attachments to stir the fungicide (or insecticide) while it is being applied; these "agitators" keep the mixture even, but if the Bordeaux is applied at once there will be little difficulty arising from unevenness of the mixture.

The mixture may be made to spread more evenly over the foliage by adding to every eight gallons of it one pound of good hard soap dissolved in a small quantity of water.†§

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*B. T. Galloway, Jr. Myc. Vol. vii, No. 1, p. 16.

†W. C. Sturgis. Seventh Ann. Rep., Conn. Agr. Exp., p. 104.

Other substances have been added and tested, but the results seem to have been less favorable. The above was suggested by D. G. Fairchild while connected with Div. Veg. Path., U. S. Dep't. of Agr.

EAU CELESTE.

Formula No. 3.

Copper Sulphate	2 pounds
Ammonia Water (strength 26° B.).	3 pints
Water	50 gallons

Put the copper sulphate into solution in a small quantity of water, using the same precautions as in preparing this for Bordeaux mixture.

When ready to spray add the three pints of ammonia, stir thoroughly, dilute to fifty gallons and apply. This is a very cheap and easily made fungicide but it is liable to scald the follage of some plants, especially egg-plant.

MODIFIED EAU CELESTE.

Formula No. 4.

Copper Sulphate	4 pounds
Carbonate of Soda (sal soda)	5 pounds
Ammonia Water (strength 26° B)	3 quarts
Water	50 gallons

Dissolve the copper sulphate as directed in preparation of Bordeaux mixture. Dissolve the carbonate of soda in hot water in a separate vessel. When both solutions have cooled, pour them together and stir the mixture briskly and add the ammonia.

This may be kept as a stock solution, that is, it may be kept some time without losing its value. Some prefer to use it double strength; in that case the mixture is diluted to twenty-five gallons, but if the above formula is to be followed, the mixture is diluted to fifty gallons.

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† S. A. Beach, N. Y. (Geneva) Exp. Sta., B. 49, p. 14.

§L. R. Jones, Vt. Exp. Sta., B. 40, p. 25.

AMMONIACAL SOLUTION OF COPPER CARBONATE.

Formula No. 5.

Carbonate of copper	8 ounces
Ammonia water (strength 26° B)	3 pints

HOW PREPARED.

Put three gallons of water in a wooden or an earthen vessel, pour the three pints of ammonia in this and stir it, to mix the two evenly. Take eight ounces of copper carbonate and shake it into the ammonia water, stirring the liquid all the while. If a considerable part of the copper carbonate remains undissolved, the liquid may be set aside to settle; if, however, all or nearly all of the copper carbonate is dissolved, more of it should be added, in the way described above, until a considerable part remains undissolved; then it is set aside as stated before. After the solution has settled, pour off the clear blue liquid into another wooden vessel. The undissolved copper carbonate may then be treated with more ammonia and water, fresh copper carbonate being added whenever the remaining portion becomes less than an ounce. If the solution is to be kept for more than a day it must be kept tightly corked.

When the fungicide is to be used, one gallon is diluted to fifteen or twenty of water.* (Peach trees and eggplant are very susceptible to scalding by chemicals, hence, fungicides need to be more diluted for these).

The stronger ammonia water is recommended because it is usually more economical to buy this and dilute it, than to buy lower per cent ammonia water and pay the additional expenses of transportation.

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*Cf. C. L. Penny, B. 22, Del. Exp. Sta., pp. 15–16.

MIXTURE OF CARBONATE OF AMMONIA AND CARBONATE OF COPPER.

Formula No. 6.

Carbonate of copper	3 ounces
Carbonate of ammonia	1 pound
Water	50 gallons

HOW PREPARED.

Pulverize the carbonate of ammonia and put into a wooden vessel, add the carbonate of copper, pour on to this two quarts of boiling water. When the chemicals are dissolved, pour into fifty gallons of water, stir to mix evenly and apply.

OTHER FORMULAS.

A great many more formulas might be given, some are much more expensive than the above, others are less efficient.

As general fungicides, the sulphur preparations have not stood the tests with the preparations that have copper as a basis; for some special diseases they are efficient.

COST OF APPLYING FUNGICIDES.

Most persons not acquainted with the work of spraying regard it as a formidable task, and one of great expense, but when it is compared with that of fertilizer it will be found comparatively light. Prof. B. T. Galloway,* Chief of the Division of Vegetable Pathology U. S. Dept. Agr., finds that it cost about $6 per acre to spray potatoes six times with Bordeaux mixture, when full strength, (see formula No. 1) is used. The result was that it increased the yield 75 to 100 per cent when used to prevent black rot, a disease causing great loss to tomato growers in this State. (See page 36, Bulletin 21; Fla. Agr. Exp. Sta.). The principal cost is the labor of applying. This may be greatly reduced, however, by fitting the machine for the special purpose and using horse power as much as possible.

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*Cf. Rep. Sec. Agr. 1892, p. 234.

A FEW HINTS.

Fungicides can in no way take the place of proper and sufficient fertilizer nor of proper cultivation. Improper cultivation and fertilization produce weak plants and these in turn invite disease. Good, strong, well-fed plants can ward off diseases that weaker ones would succumb to. The climatic conditions have much to do with the propagation and spread of plant diseases. Dry weather as a rule, being unfavorable to their multiplication. This of course is not under our control.

Many of our native wild plants harbor the parasites of our crops, hence clean cultivation and keeping the "fence row" clean has further advantages than that of looks.

It has often been observed that fields badly diseased one year are liable to be worse the next. This is so because the malady remains "in the soil." Many diseases can be greatly decreased by destroying the plants after the crop has been gathered.

ARE SPRAYED FRUITS AND VEGETABLES DANGEROUS TO HEALTH?

Some trouble has been made in this country and in England in regard to selling fruit that had been sprayed with copper compounds. At one time the board of health condemned a quantity of grapes in New York city because they had been sprayed with Bordeaux mixture. This led to an investigation by chemists.

Dr. L. L. VanSlyke, chemist to the New York Agricultural Experimental Station, choosing such bunches of grapes as seemed to contain most fungicide, found by chemical analysis that "to get an amount of copper that would be regarded serious, if taken at one dose, one would need to eat not less than 3,000 pounds of grapes, skins included, or not less than 500 pounds including stems and berries."

This estimate was made on the basis that the copper was in the form of a sulphate, but, as a matter of fact, it exists in the form of a carbonate, or a hydrate, which is not readily soluble, and hence would require more fruit than is given above.

A number of other cases might be referred to, but the above shows that it is far enough from the danger line to need no further consideration. Fruit that was unpalatable from fungicide was far from being poisonous.

HOT WATER OR JENSEN TREATMENT FOR SMUT OF OATS.

The large percentage of smutted heads in oat fields, and value of oats to this State, make it altogether proper that this simple treatment for its prevention should be given. In fields where careful estimates were made, it was found that as high as eighteen per cent. of the crop was smutted, and in no case was a field found free from it. The hot water treatment, when carried out accurately, prevents any smut from growing, but it goes farther than this, it actually increases the yield more than that represented by the loss from smut. Professors Kellerman and Swingle* found that the yield in weight of straw and of grain was increased more than double the loss represented by the smut in the untreated plats; that is to say, there were other advantages than simply to prevent the smut. Professor Arthur† has shown that the per cent of germination is not increased, but that the treated seed germinated much faster.

HOW TREATED.

Mr. J. L. Jensen, of Denmark, discovered that to plunge oats into water heated to 132° would destroy all smut pores clinging to it, and not hurt the germination of the oats, if it be not kept in the scalding water longer than fifteen minutes; but the temperature must not go above 135° nor fall below 130°.

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*2 Ann. Rep. Kan. Exp. Sta., p. 247.

†Bulletin 34, p. 88., Purdue Agr. Exp. Sta.

THE OPERATION

is described by Prof. Swingle as follows:

"Provide two large vessels—as two kettles over a fire, or boilers on a cook stove—the first containing warm water (say 110° to 130°), the second containing scalding water (132½°).

"The first is for the purpose of warming the seed preparatory to dipping it into the second. Unless this precaution is taken it will be difficult to keep the water in the second vessel at a proper temperature.

"The seed which is to be treated must be placed, a half bushel or more at a time, in a closed vessel that will allow free entrance and exit of water on all sides. For this purpose a bushel basket made of heavy wire could be used, around which spread wire netting, say twelve meshes to the inch, or an iron frame could be made at a trifling cost, over which the wire netting could be stretched. This would allow the water to pass freely and yet prevent the passage of the seed. A sack made of loosely woven material (as gunny sack), could perhaps be used instead of the wire basket. A perforated tin vessel is in some respects preferable to any of the above.

"Now dip the basket of seed in the first vessel; after a moment lift it, and, when the water has for the most part escaped, plunge it into the water again, repeating the operation several times. The object of the lifting and plunging, to which should be added also a rotary motion, is to bring every grain in contact with the hot water. Less than a minute is required for this preparatory treatment, after which plunge the basket of seed into the second vessel. If the thermometer indicates that the temperature of the water is falling, pour in hot water until it is elevated to 132½°.

If it should rise higher than 132° add small quantities of cold water. This will, doubtless, be the most simple method of keeping the proper temperature and requires only the addition of two small vessels, one for cold and one for boiling water. Keep the seed immersed for ten minutes then remove and spread out to dry at once. The treated grain may be sown any time after treatment." (The cost of this treatment will not exceed 20 cents per bushel).

POTASSIUM SULPHIDE FOR OATS SMUT.

In this treatment the seed is left twenty-four hours in a one-half per cent. solution of potassium sulphide. The published experiments seem to show that a weak solution of potassium sulphide is nearly as good as the hot water. The potassium sulphide is cheapest in the "fused" condition, in which form it costs about 25 cents a pound. One pound of the sulphide should be dissolved in 24 gallons of water. Place the seed in a wooden vessel and pour on the solution till the seed is covered several inches deep. Stir the solution before pouring it on the grain and thoroughly mix the seed several times before taking it out of the solution. The oats should stand in the solution twenty-four hours, after which they may be spread out to dry. The solution gradually loses its strength and hence cannot be used more than three or four times without being renewed.

It will probably be the best to sow the seed as soon as possible and before it becomes thoroughly dry.

Soaking the seed twelve hours in a solution of twice the strength will no doubt prove effectual.*

REMARKS ON FUNGICIDES.

1. Bordeaux mixture has held the most popular place for some time. It is best to make it with a slight excess of lime.
2. Eau celeste is cheap and effective, but is not pop-

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*Cf. Farmer's Bulletin, No. 5, Div. Veg. Path. U. S. Dept. Agriculture.

ular because it is very liable to scald the foliage of certain plants.

3. Modified Eau Celeste is no better than some cheaper form.

4. Ammonical solution of coppor carbonate as prepared by Prof. Penny (see formula No. 5), is probably the most economical and bids fair to become more popular than the old formula has been. It is the best that has been tried on tomato blight. (The old formula was followed).

5. Bordeaux mixture may be combined with Paris green to make a combined fungicide and insecticide. (See combined insecticide and fungicide).

INSECTICIDES.

There are two classes of insecticides now in common use; one that kills by poisoning, the other kills the insect by coming in contact with it. The former came into general use earlier, and it is the better where the insect feeds on the foliage of plants. The leading insecticides for leaf feeding insects are the arsenites. The most common of which is

PARIS GREEN.

Formula No. 7.

Paris green	1 pound
Water	200 gallons

Or, what would be about the same, ¼ pound to a barrel of water. While this is being applied it should be constantly agitated to keep the Paris green mixed through the water. When the powder contains some soluble form of arsenic it is liable to scald the foliage treated, this can be avoided to some extent by making it dilute as the formula directs; it needs to be applied more thoroughly, however, than when it is more concentrated. It has been recommended to add one or two pailsfull of milk of lime to two hundred gallons of the Paris green insecticide.

LONDON PURPLE.

Formula No. 8.

London purple	1 pound
Water	200 gallons

This is also an arsenite and should be used with a great deal of caution. It contains about 10 per cent. less arsenic than Paris green, but it is more caustic because more of the arsenic is soluble in water. This may be avoided, it is said, by adding a quantity of milk of lime as directed in the use of Paris green. London purple is much lighter than Paris green, so remains longer in suspension, hence requiring less stirring while it is being applied.

These arsenites may be applied in the dry or powdered form. It was formerly thought necessary to mix them with flour or some other pasty material, but the favorite way to apply it now is the concentrated form.

HOW APPLIED DRY.

A very cheap and successful machine for applying arsenites to cotton, and it will work as well for other low growing plants, is described by Prof. J. S. Newman*, as follows: "A piece of common shirting was tacked loosely to the sides of a six inch plank four feet long, forming a sack. A hole bored into the plank with a three-quarter bit, served to admit the poison; the sack covered one-third of the plank, the balance was trimmed so as to be easily handled. A man on foot holding the plank in one hand over a row of cotton, tapped it gently with the other. The fine powder seemed to be very well distributed to every part of the plant, as every worm was destroyed before perceptible injury was done."

Quite a number of arsenite dusters have been made, but in the main they agree with that described by Prof. Newman. Some have been made nine feet long with a bag large enough to hold several pounds. Eight to ten acres have been treated in a day by this process, using from one to two pounds of Paris green per acre.

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*Bulletin 17, p. 11, Ala. Ag. Exp. Sta.

A "POWDER GUN."†

for applying dry fungicides and insecticides, has been used at this Experiment Station. It distributes the arsenites quite uniformly, and with care they may be applied to the lower side of the leaves.

CAUTION.

These arsenites are poisonous to higher animals, as well as to insects, and they should not be used on vegetables nor on fruit that is full grown or nearly so. Fatalities have occurred among horses that were allowed to graze in fields where Paris green had been used.

When used in the dry form care should be taken not to walk in the "dust;" also, that all sores are protected. If one has worked with it all day, it is well to take a bath and change clothes.

KEROSENE EMULSION.

Formula No. 9.

Soap (hard or whale oil)	½ pound.
Water	1 gallon.
Kerosene	2 gallons.

PREPARATION.

Dissolve a half-pound of hard soap in a gallon of boiling water. The soap will dissolve more quickly if it is cut into small pieces and the water, with the soap in it, stirred while heating. The heating may be done in an ordinary iron kettle. When the water has heated to boiling and the soap all dissolved, the kettle may be removed from the fire and the kerosene added, care being taken not to ignite the kerosene. After the kerosene has been added the mixture should be thoroughly churned for ten minutes. A good way is to force it through a spray pump back into the kettle several times. Emulsion prepared over a fire with the water near boiling kept two years without separating entirely.

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†See Fla. Agriculturist, page 402, June 27, 1894, DeLand, Fla.

In making kerosene emulsion there are two points to be kept in mind constantly. 1st. To keep the water and kerosene just as hot as possible without igniting the kerosene. 2d. That during this time the material must be thoroughly and vigorously agitated. Merely stirring with a paddle will *not* do. Nor will it make emulsion by using warm water. The nearer the igniting point of the kerosene and the harder the material is churned, the better will be the emulsion.

The emulsion may be tested by placing a corked bottle full of it in a cool place for twenty-four hours; if no clear liquid rises to the top nor dark liquid settles to the bottom, the emulsion may be considered good.

Some trouble has been reported from the use of hard water; it is therefore recommended that rain water be used in those districts that have hard water.

When ready to use take one part of the preparation and nine of water; stir until it is mixed evenly and apply.

This insecticide is recommended for insects that obtain their food by piercing plants and sucking the sap, as plant lice. It is also an excellent remedy for the young scale before the wax has been secreted. This has also proven an excellent wash to kill lice and other parasites on animals. Care must be taken, however, that no free kerosene remains, as this will rise on the mixture and coming in contact with some tender-skinned animals, might cause the hair to fall. When diluted with twelve parts of water it has given excellent results in killing lice on cattle. It is applied to the animal with a spray or force pump.

RESIN WASH.

Formula No. 10.

Rosin (resin)	20 pounds
Caustic soda (98 per cent.)	4 lbs 4 oz.
Fish oil	3 pints
Water	20 gallons

PREPARATION.

Put all the ingredients in a large kettle and boil until they are all dissolved, when it is a dark coffee colored liquid of an even consistency. The preparation will be hastened by pulverizing the soda and the resin.* When cold dilute the mixture to 100 or 125 gallons.

Prof. Webber states that this is an effective remedy for the white fly (*Aleyrodes citrifolii*).

ANOTHER RESIN WASH.

is one recommended by the Division of Entomology, U. S. Department of Agriculture as a summer wash for the San José scale.

Formula No. 11.

Resin	20 pounds
Caustic soda (70 per strength)	5 pounds
Fish oil	3 pints
Water to make	100 gallons

PREPARATION.

Place the resin, soda and fish oil in a large kettle, put in enough water to cover four or five inches deep; then boil for an hour or an hour and a half, when the liquid will be a dark coffee brown color. Water is added gradually and the liquid stirred to keep it mixed evenly,

RESIN WASH FOR WINTER.

Formula No. 12.

Resin	30 pounds
Caustic soda (70 per cent. strength)	9 pounds
Fish oil	4½ pints

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*H. J. Webber, report to the Fla. State Hort. Soc., April 12, 1894.

The preparation of this is similar to that of formula 11. This is not recommended for a summer wash as it may do considerable damage to growing trees.

SULPHUR SPRAY.

Formula No. 13.

Flowers of sulpher	30 pounds
Caustic soda (98 per cent. strength) pulverized.	20 pounds
Water	3 gallons

PREPARATION.

Take the flowers of sulphur, place in a wooden tub large enough to hold twenty-five gallons. Wet the sulphur with three gallons of water; stir it to make a paste. Then add the caustic soda and mix it with the sulphur paste. In a few minutes it becomes very hot, turns brown and becomes a liquid; stir thoroughly and add enough water to make twenty gallons. Pour off from the sediment and keep the liquid in a tight barrel or keg until needed for use.

Of this stock solution take one or two quarts to fifty gallons for rust mite, and two to four quarts to fifty gallons for six-spotted mite (red spider) or young scale.

At the same meeting of the Florida State Horticultural Society that Prof. Webber reported the resin wash Prof. Swingle reported this sulphur spray.

LIME, SALT AND SULPHUR MIXTURE.

Formula No. 14.

Lime, fresh	8 pounds.
Salt	3 pounds.
Sulphur	4 pounds.
Water	12 gallons.

PREPARATION.

Put two pounds of lime and all the sulphur in a kettle large enough to hold fifteen gallons, pour on three gallons of water; keep the materials well mixed, and boil for an hour and a half. At first the mixture is yellow, then it turns brown, and then to a reddish brown, and finally becomes a liquid.

Six pounds of lime and three of salt are then mixed and the mixture slaked with hot water. When thoroughly done, mix with the sulphur-lime solution and boil a half hour longer, then pour in the remainder of the twelve gallons of water.

Strain the solution and apply it.

REMARKS.

This is a favorite wash for winter use in California. It is used for scale insects and for fungi, but is liable to damage trees if applied in summer or during the growing season.

It has not met with as much favor elsewhere; the main objection that comes from Florida correspondents is that a smaller amount of insecticide is made from the material and time expended than from other formulas.

SULPHUR.

This is often used for fungi and also for rust mites. The method of application is to simply throw it into the tree, or for smaller plants it is dusted over the foliage. It can be very economically and evenly applied with the "powder gun" (see page 21). It is not active enough, however, for most insects and fungi.

PYRETHRUM "BUHACH."

This powder is of a vegetable origin, being made from either of the plants, *Pyrethrum roseum* or *Pyrethrum cinerræfolium*. The flowers and stems of these plants when dried and powdered are ready for use. This powder has a great many common names and every now and then it comes out under a new name; some of the names it is known by are Dalmation powder, Persian insect powder, Buhach insect powder, etc.

Its principal value lies in that is can be used where neither the arsenites nor kerosene emulsion can be, as on cabbage and some other vegetables. It effects more or less all insects, but is most successful when used against soft bodied ones, as cabbage worms and plant lice.

APPLICATION

As a Powder.

When it is to be used as a powder it is simply dusted over the parts affected. This form is often used to protect furs and woolen goods in wardrobes.

It is also used to kill flies, mosquitoes and other insects. A small insect-powder bellows may be used to blow it over the place inhabited. If mosquitoes or flies are to be killed the doors and windows should be closed and the powder blown through the room generally. When this is done in the evening it is said that the flies may be swept up and burned in the morning.

AS FUMES.

In this form it is used mainly to kill flies and mosquitoes in rooms. The doors and windows should be closed. A teaspoonful placed on an iron plate or dustpan, is lit and burned; if it burns up rapidly the powder should be moistened until it burns slowly. The fumes are not disagreeable, and, as a rule, have no bad effect on persons.

AS A SOLUTION.

This form is usually preferred for the garden, one ounce of Pyrethrum to three gallons of water being used. Ordinarily there is no danger attending its use, as persons have taken a whole teaspoonful of the powder without proving fatal.

The powder loses much of its value by standing in an open vessel. It should be kept in a tightly closed bottle or fruit jar.

TOBACCO.

The active poisoning principle in this is nicotine, and the efficiency of this as an insecticide varies with the amount in the preparation. It may take the place of Pyrethrum in the garden, or with house plants, but wherever other insecticides can be used, tobacco preparations will be found more expensive and less effective.

PREPARATION.

The chemical analyses show so much variation in the amount of nicotine in tobacco stems and dust that no very accurate formula can be given, but usually a good decoction may be made by boiling one pound of stems in two gallons of water, for a half hour, then remove from the fire and allow it to cool in a closed vessel. When cool strain and apply, or put in tightly corked bottles until wanted for use. Apply with sprinkler, a whisp broom or a spray pump.

If the dust is to be used it is applied directly to the place infested.

NAPTHALINE.

Properly speaking this is not an insecticide, but a repellent. It is usually sold under the name of *moth-balls,* and as such commands a fancy price. In ten pound lots it is sold by wholesale chemical houses at 8 cents a pound. It is a by-product in the distillation of naphtha. At the college it has been successful in keeping out insects wherever used. The odor is not very disagreeable, though it is by no means attractive.

The application is simply to place it so the odor permeates all the goods that are to be protected.

BISULPHIDE OF CARBON.

This is an oily liquid that has a very disagreeable odor. It is very easily ignited, and so care must be taken not to bring any fire near where it is being used. This insecticide is useful only where the material to be treated is in a tight apartment. Seed in barrels or boxes or closed bins can be relieved of their insect pests. Corn in the ordinary open cribs will not be helped very much. Hen roosts, barns, storehouses, in fact, any apartment that can be closed fairly well may be freed of vermin of all descriptions by the use of this chemical.

CAUTION.

Great care and thoughtfulness must be exercised in the use of this material.

The liquid ignites much more easily than kerosene or gun powder and the vapor of this liquid explodes even more readily. The vapor can usually be smelled but *all* lights, smoking or other fire should be kept away. Carelessness in this regard may cause the loss of property and lives.

HOW USED.

With such seed as peas or beans, put a half bushel in a tight barrel, sprinkle on two or three teaspoonfuls of sulphide then put in another half bushel of seed and then some more sulphide; continue this way until all the seed has been put in or until the barrel is full, then cover tightly. This may be done by tieing over the top of the barrel a thick cloth or by placing a cloth on and then covering with boards. Use one or more ounces of sulphide to a barrel of seed.

If it is a bin that is to be cleared before storing the grain, two or three shallow dishes may be used to hold the sulphide. Use about three ounces to every hundred cubic feet of space in the bin. Put the sulphide in the dishes, and close the bin up tight and leave it so for two or three days.

If stored grain is to be freed of weevils it may be done by putting the sulphide in various portions of the grain. This can be accomplished by the use of a gas pipe. Run a stick through the gas pipe and sharpen the stick. Run the gas pipe into the grain where the sulphide is to go, draw the stick out of the gas pipe, pour an ounce or two down the gas pipe, and as soon as the sulphide has reached the end of the pipe the latter may be drawn out. If this has been properly done the carbon bisulphide will be where the end of the pipe was. Several doses of the sulphide may be placed at different parts of the bin.

If no gas pipe can be had, another way may be employed that is not quite so good, but will answer the purpose. A heavy wad of cotton is tied to the end of a stick saturated with the sulphide, and then placed into the grain as desired. It will require several wads. When there is any considerable depth of grain the carbon bisulphide* will not penetrate it, hence the necessity for putting it in different parts of the heap. The sulphide may be brought in direct contact with grain or other seed without doing any damage at all.†

COMBINED INSECTICIDES.

Numerous attempts have been made to combine the insecticides that kill by contact with those that kill by poisoning. The different arsenites have been combined with the resin washes, but as there are usually very few leaf feeding insects present where the resin washes are to be used, the combination loses its value.

Prof. L. T. Brunk of the Maryland Experiment Station,§ succeeded in making a combination of Paris green and kerosene emulsion. It was accomplished by dissolving twenty-seven ounces of hard soap in a gallon of hot water; this was poured into a half barrel; to this was added one pound of copper carbonate, and then two and one-half ounces of Paris green. The whole was then thoroughly mixed by running it through a spraying machine several times.

After the emulsion was fully formed the mixture was diluted to twenty-eight gallons. The mixture was found to be very sticky, and so is recommended for the earlier applications only.

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*Carbon bisulphide is advertised for ten cents a pound in fifty-pound lots by Edward R. Taylor, Cleveland, Ohio.

†Cf. B. 17 Miss. Agr. Exp. Sta., H. E. Weed.

§Md. 4th Ann. Rep., page 386.

COMBINED FUNGICIDES AND INSECTICIDES.

As the cost of applying fungicides and insecticides is greater than the cost of the materials used, experimenters are working to reduce this to a minimum. It has often occurred that a crop needed a fungicide and an insecticide at the same time. Now, if the two could be combined, the cost of applying the combination would be just one-half that of applying them separately. The proposition seems plain enough, but when one gets into the actual work, a great many questions arise that were not apparent at first. However, such combinations have been discovered, and what is still better, the combination is not only as efficient as each preparation applied separately, but the efficiency* of the insecticide is actually increased.

Formula No. 15.

Bordeaux mixture	50 gallons
London purple	¼ pound

Prepare the Bordeaux as directed in formula No. 2 as desired, and just before applying stir in the London purple and apply. Paris green may be substituted for the London purple, but the latter has some advantages over the former. White arsenic should not be substituted, however.

REMEDIES THAT HAVE FAILED.

SALT.

This has often been recommended for various evils, among them wire worms and cut worms. Prof. Comstock of Cornell University tested it for the former pests and found that it could not be considered a remedy.

DECOCTION OF JAMESTOWN WEED (THORN APPLE).

has been recommended as a specific for cut worms, but it did not kill the larvæ of Colorado potato beetle when applied to best advantage.

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*C. P. Gillette, Bulletin 10, Ia. Ag. Exp. Sta., pages 401–420.

DECOCTION OF CHINA-TREE LEAVES

has been recommended without limitation as a slayer of insects. Although when the regulation formula was followed as closely as possible we found that even the most delicate insects were not killed by a thorough application of the decoction.

Herbarium specimens of the above tree suffer as badly as any other in our herbarium.

CHINA BERRIES

have been recommended as preventatives for moths, weevil and pests in general. Boxes at the college containing these and other specimens became infested with moths, weevils and other beetles. Prof. H. E. Weed of Mississippi Agricultural Experiment Station, has had similar experience in connection with stored grain. (Bulletin 17, p. 11).

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REMARKS ON INSECTICIDES.

1. There are a great many insecticides on the market; some are of excellent merit. Most of them follow, or make slight variations from the formulas given in experiment station or government reports.
2. Paris green is the favorite form of arsenites. It should be used with a great deal of caution.
3. Resin wash, Formula No. 10, is probably the best for scale insects. It has not been tried by the station.
4. The sulphur preparations have also a fungicidal property, but it is not very active.
5. Carbon bisulphide can be used to advantage in a great many places.
6. The combined insecticide and fungicide is a decided acquisition.

COST OF MATERIALS FOR MAKING SPRAYING SOLUTIONS, AND WHERE THEY MAY BE OBTAINED.

Below is given a table showing the cost of chemicals recommended in this bulletin when bought in the quantity given in this table. If a large quantity is to be used it can be had cheaper. These chemicals may be obtained from J. C. L'Engle, No. 1 East Bay street, Jacksonville, Fla.:

Ammonia water (26° B), in 7-pound bottles, 10 cents per pound, and 20 cents for the bottle.

Arsenic, white, 10 cents per pound.

Carbonate of ammonia, 12 cents per pound.

Carbonate of soda (sal soda), in 5-pound packages, 4 cents per pound.

Carbon bi-sulphide (bi-sulphide of carbon), 25 cents per pound, in 1-pound cans.

Caustic soda (70 per cent), in 50-pound cans, 6½ cents per pound.

Copper carbonate, 46 cents per pound.

Copper sulphate (blue stone), 6 cents per pound, in 10-pound packages.

Lime, quick, 75 cents per barrel.

London purple, 27 cents per pound.

Napthaline, 8 cents per pound, in 10-pound cans.

Paris green, 26 cents per pound.

Potassium sulphide, 39 cents per pound, in 5 pound packages.

Pyrethrum, insect powder, 21 cents per pound.

Resin, Rosin, $2 per barrel of 180 pounds.

Sulphur (flowers), 3 cents per pound, in 50-pound packages.

Tobacco dust, barrels, 3 cents; smaller quantities 4 cents.

Tobacco stems, 1½ cents per pound, in 50-pound packages.

FUNGICIDE AND INSECTICIDE TABLE.

At the suggestion of Dr. Clute the following table has been prepared. Such an outline must necessarily be brief;

in fact, its whole value lies in its being brief and bringing together facts deduced from elaborate treatises. One may know, also, under what heading to look for fuller discussion of any particular remedy.

HOW TO USE THE TABLE.

The method of using the table hardly needs explanation. The first column to the left contains the names of plants in common cultivation in alphabetical order. The second column contains the names of diseases of the plants named in the first column.

The first disease that a remedy is given for is placed directly opposite the name of the plant. The name of the second disease of that plant, if given, is placed directly under the first, and so on. Directly opposite the disease is given the remedy. If there are two or more remedies given for the same disease the second is placed under the first, and so on. The mode of treatment is placed in the fourth column opposite the remedy. To illustrate, let us suppose the trouble is with a peach, looking down the first column we find peach, opposite this in the second column is *San Jose scale;* below this *peach louse, plant louse, black louse, curculio,* but none is the disease we are looking for; finally we come to *spotting on the fruit*; as this is what we are looking for we will look opposite the third column for the remedy, which we find to be *ammoniacal solution of copper carbonate,* and opposite this in the fourth column we are advised to spray when the fruit has set, and then repeat every ten days or two weeks.

The above table should not be considered complete. A single instance, that of the grape, may be cited, which has more known diseases than the total number given in the second column.

TABLE FOR USE OF FUNGICIDES AND INSECTICIDES.

Plant.	Disease.	Remedy.	How Used.
Beans.	Brown spot of pod: young plants, and leaves. (*Colletotrichum Lindemuthianum*.)	Ammonical Solution of Copper Carbonate. Bordeaux Mixture.	Soak the Seed 24 hours: plant; spray plants every ten days or two weeks
	Blight. (*Sclerotium s p.*)	Eau Celeste. Ammonical solution of Copper Carbonate	At first signs spray stems, roots and soil about the plant every ten days or two weeks.
	Weevils. (*Bruchus obsoletus*)	Carbon bi-sulphide.	Use in closed bin or barrel.
		Napthaline.	Odor keeps them out
Cabbage.	Blight. (*Sclerotium s p*)	Same as for beans	Same as for beans
	"Worms," (*Larvæ of Lepidoptera*)	Pyrethrum.	Dust or spray on plants.
		Paris Green, London Purple.	Not advised.
	Harlequin bug. Calico bug, (*Murgantia histronica*.)		Pick off. Destroy eggs.
Cucumbers.	Cucumber louse, melon louse, hession fly, (*Aphis cucumeris*.)	Kerosene Emulsion.	Apply thoroughly to the under side of leaves of infested plants.
	Cucumber bug (beetle) (*Diabrotica 12-punctata*.)	Tobacco stems.	Placed on the hill as the plants begin to come up.
Eggplant.	Leaf spot fungus. (*Phillosticta hortorium*.)	Bordeaux Mixture, Ammonical solution of copper carbonate.	Destroy all leaves and fruit attacked; spray leaves and fruit every 10 days or two weeks.
	Blight. (*Sclerotium sp.*)	Same as for bean blight.	Same as for bean blight.
Grapes.	Black rot. (*Loestadia bidwellii*.)	Bordeaux mixture Eau Celeste. Ammonical solution of Copper Carbonate.	Spray stems when buds begin to swell and then every 12 days until fruit is full grown. Do not use Bordeaux the last two times; it colors the fruit.
	"Worms." (*Various Larvæ*.)		Hand picking of the earliest broods.

TABLE FOR USE OF FUNGICIDES AND INSECTICIDES.

Plant.	Diseases.	Remedy.	How Used.
Oats.	Smut (*Ustilago avenæ*).	Hot water. Potassium sulphide.	See page (28)
Orange.	Rust mites (*Phytops*).	Sulphur spray.	Spray in May or June (before they migrate to the fruit).
		Sulphur.	Dusted over leaves and among branches in May or June.
	Red spider (*Tetryancus 6-maculatus*).	Kerosene emulsion, sulphur spray	Use as an ordinary spray.
		Water.	Used with irrigating plant.
	Red scale (*Aspidiotus ficus*).	Resin wash, Lime, salt and sulphur spray.	Spray when the insects are bad; before rainy season preferred.
	Long Scale (*Mytilaspis gloveri*).	Same as Red Scale.	Spray in March or April (when larvæ are moving) also in June or July and in September or October. Repeat spraying at short intervals.
	White fly (*Aleyrodes citrifoli*)	Rosin wash.	Spray under side leaves thoroughly before "fly" becomes winged.
Peach.	San Jose scale(*Aspidiotus peniciosus*)	Rosin wash. Summer wash. Winter wash.	Burn on the spot all badly infested trees.
		Kerosene emulsion. Lime, salt and sulphur.	Spray thoroughly and repeat every ten days or two weeks.
	Plant louse, peach louse (*Myzus cerasi*)	Kerosene emulsion.	Spray forcibly on underside of leaves
	Black louse (*Aphis persicaeniger*).	Kerosene emul'n	Same as above.
	Curculio (*Conotrachelus nenuphar*)	Paris green. London purple.	Spray when fruit has well set: repeat every ten days.
	Spotting on fruit. (*Cladosporium carpophilum*).	Ammoniacal solution of copper carbonate.	Spray when fruit has set; repeat every ten days or two weeks.
Pear.	Blight, fire blight (*Micrococus amylovorous*).	(No treatment has stood the test).	Cut out the diseased parts to a foot below where blight shows. Burn part cut out.

TABLE FOR USE OF FUNGICIDES AND INSECTICIDES.

Plant.	Disease.	Remedy.	How Used.
Pear. (Con.)	Scab. (on fruit). (*Fusicladium pyrinum*).	Bordeaux mixture. Modified Eau Celeste. Ammonacal solution of Copper carbonate.	Spray 1st, before leaves appear. 2d. Just after. 3d. When fruit has formed. 4th. At intervals of ten days until fruit is nearly grown.
	San Jose Scale, (*Aspidiotus perniciosus*).	Same as when affecting peach.	Same as when affecting peach.
Plums.	San Jose Scale.	Same as for peach	Same as for peach
	Curculio.	Same as for peach	Same as for peach
	Brown rot. (*Monilla fructegena*.)	Bordeaux mixture. Ammonacal solution of Copper carbonate.	Spray when buds begin to swell, again when fruit has set, then every ten days or two weeks.
	Shot-hole fungus. (*Septoria cerasina*.)	Bordeaux mixture. Ammonacal solution of Copper carbonate,	When leaf buds begin to open, and repeat every ten days or two weeks until leaves are full grown.
Potato. (Irish.)	Black rot. (*Macrosporium solani*.)	Bordeaux mixture. Modified Eau Celeste. Ammonacal solution of Copper carbonate.	Spray as soon as plants are well up. Repeat every ten days.
	Blight. (*Sclerotium*.)	Same as for bean blight.	Same as for bean blight; use about a pint of fungicide to a plant.
Seed (Various kinds).	Weevils and Moths.	Napthaline.	Place among and on top of seed in closed boxes.
		Carbon bisulphide	Kills. (See page (28)
Tomato	Blight. (*Sclerotium sp*).	Same as for potato blight.	Same as for potato blight.
	Black rot. (*Macrosporium solani*.	Same as potato black rot	Same as potato black rot.
	Leaf blight. (*Cladosporium fulvum*.	Bordeaux Mixture. Ammonical solution of Copper carbonate	Spray on first appearance, then every ten days or two weeks

nated above, will it be necessary to use in order to supply 160 lbs. of Phosphoric acid? To answer this, we revert to the analysis of the acid phosphate and find that it is guaranteed to contain 20 per cent of phosphoric acid. Now, then, we reason that if each one hundred pounds of the acid phosphate contain 20 lbs. of phosphoric acid, it will require as many hundred pounds of this phosphate to provide 160 lbs. of phosphoric acid as 20 is contained times into 160, or, in other words, it will be necessary to employ 800 lbs. of the acid phosphate in order to provide the necessary 160 lbs. of phosphoric acid.

A similar course of reasoning, with a view to ascertaining the amount of muriate of potash and nitrate of soda to be used for supplying the requisite amounts of Potash and Nitrogen, will show that 480 lbs. of Muriate of Potash and 1000 lbs. of Nitrate of Soda will have to be employed. We find, therefore, that in supplying the requisite number of pounds of phosphoric acid, potash and nitrogen, we have employed:

800 lbs. Acid phosphate
480 lbs. Muriate potash
1,000 lbs. Nitrate soda, or

2,280 lbs. of mixture.

We see, therefore, that instead of our mixture containing 160 lbs. of phosphoric acid (i. e., 8% of 2,000) in one ton, it contains 160 lbs. in 2,280 lbs.

Plainly, then, the mixture will not analyze 8.00 per cent. of phosphoric acid, but only about 7.00 per cent. (i. e., 160 divided by 2,280 = 7.00 per cent.) The same would be found true with reference to the potash and nitrogen. It is very evident, therefore, that it is impossible to make a ton of mixture of the strength designated, out of the material at hand. Unmixed material, more concentrated, will have to be resorted to.

It does not always happen that a fertilizer mixture so concentrated as the one mentioned above will be desirable, and, hence, it will not often be found necessary to prepare such a mixture, but when it is deemed desirable to employ such an one, care should be exercised to purchase unmixed mateial sufficiently rich in the several plant food elements as not to aggregate more than the quantity of mixture it was desired to prepare. If, for instance, you desire to mix one ton, use material that will supply the necessary number of pounds of the several plant foods, and at the same time not weigh more than 2,000 lbs. when mixed. If the several bstances used are sufficiently concentrated to provide the desired quantities of plant food, per ton, without employing as much as 2,000 lbs. of the mixed material, then, of course, all that will be necessary, will be to fill in the remainder of the 2,000 lbs. with some cheap filling, such as sand. The accuracy of the mixture will not be appreciably impaired, because we know that in each ton of such a mixture, there will be present the necessary number of pounds of the several plant-food substances. Here in Florida, a suitable fertilizer for fruit crops in general should probably be proportioned about as follows:

Phosphoric acid	6.00 per cent. (available)
Potash . .	10.00 per cent.
Nitrogen . .	5.00 per cent.

Let us suppose that we desire to make up a ton (2,000 lbs.) of mixture which would analyze as stated above. We will use the same material that was used in the other instance, for supplying the desired quantity of the several constituents of plant food. Pursuing the same course of reasoning that has already been given, it will be found that a ton of this mixture must contain 120 lbs. phosphoric acid, 200 lbs. potash, and 100 lbs. nitrogen; and by another process of reasoning, already described, it will be found, further, that the following quantities will have to be used to provide these several amounts of plant food:

600 lbs. Acid phosphate
400 lbs. Muriate potash
625 lbs. Nitrate soda, or

1,625 lbs. of the mixed material will provide the requisite amounts of the several plant foods. Now, to make exactly one ton, all that is necessary, is to add 375 lbs. of some cheap filling, such as sand, etc., which has little or no fertilizing value.

Then, in the ton of mixture, so prepared, there will be present 120 lbs. of available phosphoric acid, 200 lbs. potash and 100 lbs. nitrogen. This mixture, when thoroughly prepared, should analyze:

Phosphoric acid	6.00 per cent.
Potash . .	10.00 per cent.
Nitrogen . .	5.00 per cent.

With this data at hand, it should be an easy matter for every farmer to mix and prepare his fertilizers at home, of any desired strength, but the greatest care should invariably be exercised to insure thorough mixing.

Bulletin No. 23. December, 1893.

FLORIDA
AGRICULTURAL EXPERIMENT
STATION.

INSECTICIDES AND FUNGICIDES.

P. H. ROLFS.

The Bulletin of this Station will be sent free to any address in Florida
upon application to the Director of the Experiment
Station, Lake City, Fla.

THE DA COST PRINTING HOUSE, JACKSONVILLE, FLORIDA.

LETTER OF TRANSMISSION.

LAKE CITY, FLA., January 18th, 1894.

To the Hon. H. L. Mitchell, Governor of Florida,
and
To the Honorable Board of Trustees
of the Florida Agricultural College,

Gentlemen:—

I submit to you herewith my first annual report as Director of the Florida Experiment Station, being for the period extending from September 18th, 1893, to December 31st, 1893.

Very respectfully yours,
O. CLUTE,
Director.

LAKE CITY, FLA., January 18, 1894.

To the Hon. H. L. Mitchell, Governor of Florida,

and

To the Honorable Board of Trustees

of the Florida Agricultural College,

Sirs :—

My term of office as Director of the Florida Experiment Station began on September 1st, 1893, hence this report, so far as my own work is concerned, embraces only the last four months of the year 1893. When I entered upon duty there came into my hands no unpublished notes of experiments either complete or incomplete, hence it was necessary for me to initiate work.

One of the first things that came to my notice in regard to agriculture in Florida, is that the State does not produce enough forage and grain for home consumption. Large sums are now paid annually for forage and grain grown north of us. If this forage and this grain, especially the grain for feeding stock, can be grown in Florida these large sums will be saved, it will be made possible to produce the meats consumed in the State, and a large production of valuable fertilizers will result as a by-product. Hence I began immediately to experiment with the growth of winter forage. Plats have been sown with oats, rye, barley, wheat, rape, turnips, ruta-baga, kale and collards, with a view of learning the profit of growing these as forage crops during our winter season. It seems to me that with our cheap lands and our incomparable climate, we can grow better fodder and at less expense than any other State. I hope to prove this, and shall leave no means of doing so untried.

I shall continue to work with the crops mentioned above, and shall add to the list various millets, Kaffir corn, Milo maize, Teosinte, Guinea grass, Flat pea (Lathyrus silvestris), Polygonum sachaliense, goobers, chufas and sweet potatoes.

My experience as Director of the Michigan Experiment Station with the Flat pea was most encouraging, and as soon as seed can be procured I will try the plant here.

The prices of cotton just now are very low, and much discouragement exists among cotton growers. It therefore becomes necessary to learn if more productive varieties of cotton of better quality can be grown at less expense. To this subject careful attention will be given.

Tobacco growing is just now in a very depressed state, owing to the uncertainty of the tariff. It has been made clear by years of successful experience that a superior article of tobacco can be grown in Florida. But much remains to be done in learning the best varieties, soil, cultivation, fertilizers and curing. To this work the Station at Lake City will give attention.

Many Florida farmers desire to grow sugar cane to make syrup and sugar for home consumption. It would not be surprising should this State again produce large quantities of sugar as a commercial article. Experiments in growing cane, including varieties, soil, fertilizers and cultivation will be made in the near future.

The production of up-land rice may become a much larger and a much more profitable industry than at present. I shall procure promising varieties from Japan, China, India and other rice growing centers. Attention will also be given to the growth of low-land rice, as there are large acres of Florida where this rice can be profitably cultivated.

The climate and soil of Florida give it unexampled facilities for the growth of truck and fruit. This industry is yet in its infancy. Much remains to be learned as to varieties, seasons, cultivation and fertilizers. We shall from year to year carry on experiments to discover what may be done in all these directions. The experiments in truck farming will be carried on mainly in Lake City.

Olive culture is so valuable an industry wherever the olive will thrive, that we should try to learn if it will thrive in this State. To this end I shall have olive trees set at our three stations, and in other parts of Florida, this spring. The fig is one of the important fruit crops of the world. We should learn if the fig can be grown and cured on a lage scale in Florida. A few trees will be set out this spring, and others as fast as I learn of promising varieties.

The annual report of Prof. J. N. Whitner, Horticulturist of the Station, is printed in the appendix; marked A.

Investigations as to the insect pests of the various farm, orchard and garden crops, and also as to fungoid diseases, are among the most essential helps to modern agriculture. Much has been learned by investigation in all parts of the world in the last few years to aid the agriculturist to conquer these foes. But much more remains to be done. A department of our Experiment Station will devote much time to this work. This department is now led by Prof. P. H. Rolfs. It gives me much pleasure to call your attention to the fact that under him Florida is not behind other States in original valuable discoveries in this line. Prof. Rolfs is the discoverer of the cause of the disease known as tomato blight, one of the most destructive fungoid diseases to which the tomato is subject in this State. He has pointed out a remedy which promises to hold it in check. His work in this immediate direction will be carried on during the coming year with careful attention. Prof. Rolfs is not unfrequently called to different parts of the State to investigate various pests, and to advise as to remedies. He recently discovered the presence at DeFuniak Springs of a most destructive enemy to several varieties of deciduous fruits. I refer to the San Jose scale, which is found at that point diffused through several orchards. I am now in communication with the fruit growers of DeFuniak, and with the Department of Agriculture in Washington, as to the steps necessary to exterminate this scale before it has made further progress. The seriousness of the matter cannot be overestimated. If this scale is allowed to spread, the fruit industry will be ruined wherever the pest gets a strong hold. I shall give much attention to this, and hope next year to be able to report that every scale has been wiped out.

The work done and in progress in regard to tomato blight and San Jose scale, is but a sample of the immediate service the Experiment Station can do for all the agricultural industries of the State. Diseases of the pineapple, the citrus fruits, the peach, the pear, the mango, have already received attention, but all need constant study by men trained for the work. A brief report of Prof. Rolfs is appended, marked B.

As to the insect pests of citrus fruits, I call attention to the fact that the Department of Agriculture in Washington has a special agent in Florida for this work—Mr. H. G. Hubbard, Crescent City, who is considered the ablest man in America on the insects that infest citrus fruits. The Department of Agriculture has also a Sub-Tropical Laboratory at Eustis, for the study of the diseases of citrus fruits. This laboratory is in charge of Prof. W. T. Swingle and Prof. H. J. Webber, who are most thoroughly trained. As they have a well equipped laboratory, and are in the midst of the "Orange Belt," they have every advantage for the pursuit of these special lines. From the investigations of these three men we may expect most valuable results.

As the pests and diseases of the citrus family are thus in such competent hands, our Florida Experiment Station need not take up this line of investigation, but give its efforts in other directions.

The dependence of modern agriculture upon chemistry is most intimate. Knowledge of soils, fertilizers, the constituents of various crops, and the nutritive value to man or beast of the food crops, comes directly from chemical investigation. The chemist of the Experiment Station, Prof. A. A. Persons, is largely employed in answering the numerous questions in his department which come to my office, and in analyzing material sent in from all parts of the State. He is also at present engaged in determining the nutritive value of the orange, work which has not heretofore been done in Florida. For a report of the Chemist see appendix C.

Dr. A. W. Bitting, the former able veterinarian of the Experiment Station, was called in June last to a more lucrative position in the Indiana Experiment Station. It has not been possible as yet to resume work in this department. The large and increasing livestock interest of this State, and the presence among our stock of certain diseases that are peculiar to the State, make it important that we enter upon investigations as to livestock diseases as soon as possible. "Big head," "leeches," "salt sickness," are three very serious diseases, concerning which Dr. Bitting had made important studies before leaving Florida. It is is a misfortune that his work should be lost to the State. I append a brief report of his work up to the time of his resignation, marked D.

The branch Experiment Station at DeFuniak is under the charge of J. T. Stubbs, Esq. He has done as well as could be expected considering the conditions. The work is in a very undeveloped state, owing to inferior location and lack of funds. I hope to put more money into subdueing more land, and in planting orchard fruits and small fruits. Probably it will be well to confine tests with deciduous fruits and small fruits mainly to the DeFuniak Branch Station. Something can also be done here with farm and garden crops. A report from Mr. Stubbs, marked E, is submitted.

At Fort Myers, in Lee county, south of the Caloosahatchie river, the Experiment Station has a branch. It is located on the bank of the river about one and one-fourth miles from the Fort Myers postoffice. The location is a very good one. The soil is about the same as that of other large portions of South Florida. The work here has been from the beginning in charge of Dr. L. C. Washburne. The place is not in as good order as it should be. This may in a measure be due to a lack of money and to the large amount of labor required to open up a new farm. Much should be done without delay to put the work here in better condition.

The sub-tropical portion of Florida, including the immense area south of the 25th parallel of latitude, has a climate that enables it to grow products that cannot be produced elsewhere in the State, nor in the United States. Some of these can be profitably grown and marketed during the winter. To lead in discovering fruits, vegetables, and farm crops adapted to this section, and in learning the fertilizers and methods of cultivation, is a most important work for the development of Florida, and for the Station to enter upon. I hope that this work can go on with increasing success. A report from Dr. Washburne is attached, marked F.

In closing this report permit me to call your attention to the unsatisfactory location of the Experiment farm at Lake City. The land so slopes and is so lacking in tenacity that after every heavy rain we find that much of the surface has been carried into Alligator Lake. More valuable use could be made of the present farm by putting it into permanent pasture of Bermuda grass, or by planting it to groves of nut-bearing trees; but we ought not to depend upon it alone for our most important and delicate experiments. Other land, level in character, should be added to the present farm.

At DeFuniak Springs also our forty-acre piece is badly divided by ravines, which receive the water from many acres, so that during heavy rains the ravines become torrents. Here good land adjacent to our present farm should be added to it. In a State where there is so much good land, well located, it is not wise economy for any of our Experiment Stations to be confined to an unfavorable location.

Very respectfully yours,

O. CLUTE,

Director.

A

Report of Horticulturist.

FLORIDA EXPERIMENT STATION, January 13, 1894.

President Oscar Clute, Director,

SIR:—Practical work in this Department has been chiefly directed toward improving the cultural condition of the grounds of garden and orchard, in order that more reliable results in future experiments might be expected.

The lands of this Station belong to that class which is known in Forida as "light sandy hammock;" they are also "high and rolling." The forest growth of these lands consists largely of water oak, magnolia, hickory, pine, beach, live-oak, etc. The tenacity, or cohesive properties, of the particles of soil being weak, and the clay sub-soil somewhat distant, most of the organic matter washes away very soon after the restraining effect of the roots of the forest growth is destroyed by decay. To prevent so serious a loss, terracing for garden and orchard, and horizontaling for field and cultivation, should be adopted before a plow is ever used. Nor is it advisable, on these light soils, to make the terraces or horizontal beds on a dead level, but allow a fall of 4 to 6 inches to the 100 feet to carry safely into hillside drains all surplus water after very heavy rains.

In the cultivation of vegetables special attention was bestowed upon cauliflowers, early cabbages, celery and tomatoes as a table fruit.

Celery seeds of Giant Paschal, Golden Dwarf, and Self-Blanching varieties were sown September 29; they should have been planted in July. Seeds of Early Paris, Autumn Giant, Late Algiers cauliflowers; Early Walcheren Broccoli, and several varieties of cabbages, were sown October 6. The first of the Brassicas to head was the Charleston Wakefield cabbage, January 12; next, Early Paris cauliflower, January 15; then Broccoli, February 12, and Autumn Giant and Late Algiers cauliflowers, March 6th and 15th, respectively.

The Early Paris, besides being from one to two months earlier than the others, is of more delicate flavor, and occupying less space, because of its compactness of growth, may be planted closer. The later varieties, however, are not so liable to be injured by frost while in flower.

The Charleston Wakefield cabbage, a seedling of the Jersey Wakefield, though considerably larger, produced firm, handsome heads in 98 days from sowing the seeds, and 40 days from the date of transplanting. It was entirely free from insect disturbance, while plant lice were infesting other varieties in the same field.

The experiments with celery pointed to the greater excellence of the Giant Paschal over all others, when matured and consumed during cool weather, which early July planting will ensure. Both dwarf and giant varieties were ready for use, well blanched, 12 to 18 inches, solid, tender and crisp, in six and one-half months from the seed.

ORCHARD VINEYARD, SMALL FRUITS, ETC.

As a beginning, we have three varieties of the olive (Olea Europaea), viz.: Mission, Picholine and Gentili, now under experiment.

Bearing olive trees are to be found in several places in this State, and also on the coast of Southeast Georgia, but no one, so far as known, has engaged to any extent in the cultivation of this fruit now so profitably grown in California. Dr. Morse, of San Mateo, Cal., gives the following interesting information respecting early varieties, etc.:

"At the third State Convention of Olive Growers held last July (1893), Mr. Howland, of Pomona, stated that his olive trees, embracing nine varieties, were planted five years ago the 17th of last April, and were two years old when planted. Seven of the varieties commenced to bear the second year, and have borne regular and steady crops ever since. Two of the varieties bore for the first time last year." He says: "All the bearing part of my orchard—five years old—returned me over $400 per acre last season, the fruit being made into oil. The Pedulina, Rubra and Columella paid me about $7.50 per tree."

When the people of Florida can be assured results corresponding to those described above, olive culture will become a leading industry in this State.

Upwards of three hundred plants of the citrus trifoliata were set out last March, to determine its value as a barrier hedge plant, and is growing well. We have some choice varieties of the orange—Dancey's Tangerine, Maltese Blood, Mediterranean Sweet, Satsuma, etc.—budded a year ago on this popular (trifoliata) stock.

In the Station orchard are quite a number of fine fruit trees in bearing, among them young Satsuma oranges and well developed LeConte pear trees. Besides these are peach trees, without label or record of name, and in an unthrifty condition from the ravages of the borer (Ægeriæxitiosa), Japan persimmons and oriental pears, no names, and a lot of promising looking fig bushes which are believed to have been imported from Europe by the United States Department of Agriculture.

VINEYARD.

Forty Italian grape vines, representing as many different varieties, with roots well preserved, were received from California and planted out February 13 with the hope that some of them might develop sufficient merit to warrant grafting upon native stock. In the old vineyard are a few vines left, some with fruit, but the varieties are not known.

SMALL FRUITS.

Mr. J. C. Rogers, of Morristown, N. J., sent us about two dozen Enhance strawberry plants for trial in this climate. They were planted November 20, grew rapidly, began bearing the last of February and continued to bear uninterruptedly to June 30. The fruit is of good size, of rather irregular shape and very sweet, but does not ripen uniformly. We are also experimenting with the Everbearing (Australian) strawberry obtained from California. Since it seems to be impossible to grow the raspberry in Florida, we are deeply interested in the Logan plant, of which we have a few. This plant is a cross between the rasp and blackberries and originated in California. Two of our plants, though not planted until the 1st of May, produced ripe berries 15th of June.

Respectfully submitted,

J. N. WHITNER, *Horticulturist.*

B

Report of the Botanist and Entomologist.

Dr. O. Clute, Director,

Dear Sir:—The past season has been an exceptional one for fungus and insect diseases of plants. The prolonged cold of the winter, followed by a cool, moist spring, seemed to make conditions proper for the development of these disorders.

Some of the tests of fungicides for tomato blight were deemed complete enough to report on, and were published in Bulletin No. 21. Other tests were carried on, but they should be repeated two or more times before any conclusions are drawn from them.

EGG PLANT.

The effect of Bordeaux mixture and ammoniacal solution of copper carbonate was tried on egg-plant-blight, or tomato blight. The field was particularly well adapted to the test, inasmuch as this disease was exceedingly abundant. The field was divided into thirteen plots, six of which were used for checks and seven were treated. The first application was made on June 23rd, the second on July 8th, the third on July 19th, and the fourth on July 29th. Further work on this will be done in other years.

At the same time there was present on the egg-plant the leaf-spot fungus, *Phyllosticta hortorum*, Speg.; the effect of the above named fungicides on this was also noted.

Where egg-plant can be grown free from diseases it is a profitable employment, but the above named diseases are so generally distributed that it is usually unprofitable.

PLUM.

The Kelsey and other plums suffer severely from the shot-hole fungus; several fungicides were tried on trees at the station. The treatment was begun on March

13th. There seemed to be an advantage from using Bordeaux mixture and Eau Celeste, but no difference was detected between those treated with Par Odium and the checks.

Paris green and London purple were used as preventatives from the attack of the plum curculio. While there was a decided advantage in using these arsenites, the exact amount could not be ascertained for unavoidable reasons.

PEACHES.

The tests made in the peach orchard for remedies for curculio were very similar to those on the plum trees and the results in a great degree the same.

TOBACCO SEEDLINGS.

While testing some tobacco seed it was found that some seedlings assumed strange forms and in a few days would die, apparently damp-off. On furthur study it was discovered that *Heterodera radicicola* was responsible for the disorder. The seedlings were grown on moist sand that had been brought in from the field ten months before and had been kept in an air dry condition during the entire time up to its use in the germinator. The sand had been selected as being "clean."

When the seedling was attacked at once on sprouting, it assumed the shape represented by Fig. 1 and succumbed. When attacked after the radicle had grown several times the diameter of the seed the form may be represented by Fig. 2; if, however, the radicle had grown several times this length Fig. 3 shows the form it took. When a seedling had become well established before being attacked the œdematous condition would be at the point of attack; it was not uncommon for an established seedling to have two or several such enlargements, making it appear like a small string of beads. Fig. 4 represents a seedling attacked just below the cotyledons, though this was not more common than for them to be attacked at some other point. Fig. 5 represents a healthy seedling. All magnified ten times.

The irritation is produced by the nematodes from the outside; that is, it should not be understood that the guest enters the tissue of the host, but the enlargement is

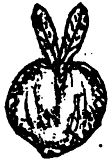

Fig. 1.

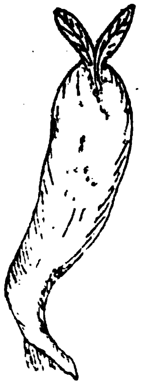

Fig. 2.

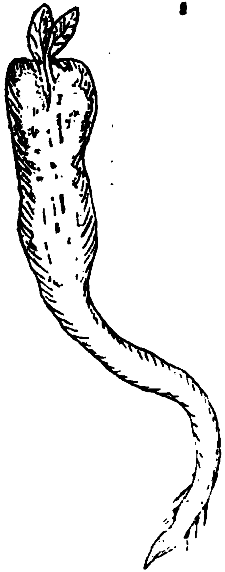

Fig. 3.

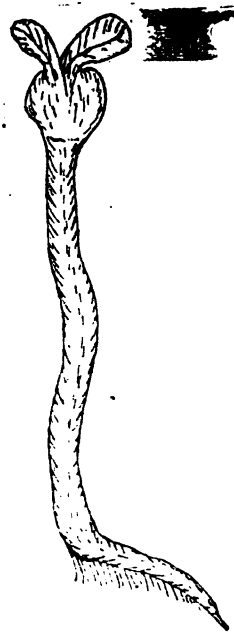

Fig. 4.

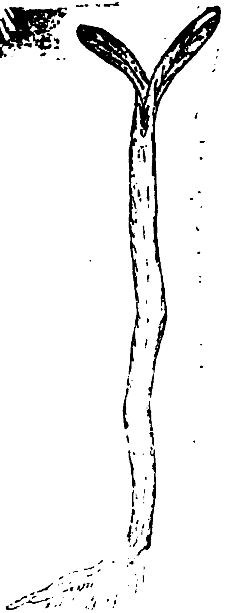

Fig. 5.

brought about by an external presence. The effect is quite evenly distributed throughout the entire diameter. The result is brought about by an œdematous condition of the individual cell, and not by a multiplication of cells at the point of irritation. The cotyledons are arrested in their development while the caulicle fails to appear at all. The radicle continues to develop for a time but later succumbs, probably from the want of response of the foliage system.

All the forms figured above appear as seedlings in the seed-bed, and make it look promising for a heavy stand, but in a week or two they all "damp off."

From the foregoing it is plain that seed-beds should not be made on lands infested with root-knot (*Heterodera radicicola*). Old land is apt to be infested, but we can be certain of the infection only by observation of the trouble in some crops grown.

ENTOMOLOGY.

Thirty-six cases for holding entomological specimens were purchased to hold the Hymenoptera and the Diptera. These orders have been placed in order, Packard's Guide being used for the sequence of families.

Twelve cages for rearing insects were added.

BOTANY.

Four hundred herbarium sheets were added to the collection. The specimens were mostly collected in Florida. The work of mounting was done by students.

Lake City, January 8, 1894.

C

Report of Chemist.

LAKE CITY, FLA., Jan. 15, 1894.

D. O. Clute, Director, Lake City, Fla.,

DEAR SIR:—I respectfully submit the following report of the work done by me as Chemist of the Florida Experiment Station for the year ending December 31, 1893.

My time has been consumed in the analysis of various agricultural products, etc., for the Station and for various parties throughout the State. The samples analyzed were more than one hundred in number and included phosphates, fertilizers, soils, mucks, marls, mineral waters, feed stuffs, etc., and, in addition, a chemical study of the orange was undertaken with a view to ascertaining the comparative nutrine value of different varieties, and also the amount of fertilizing constituents removed by them from the soil during growth. The investigation was preliminary and will be continued the present year.

This Department also issued a bulletin in September on "Soils and Fertilizers," which has met with a generous reception from both press and people of the State.

Respectfully submitted,

A. A. PERSONS,

Chemist Experiment Station.

D

Report of the Veterinary Department.

To O. Clute, Director:

The diseases which have been given special attention, are known by the local terms, "big-head," "leeches" and "salt sick." The first and second are confined almost exclusively to the horse, and the last to cattle. It is difficult to estimate the loss caused by these diseases, but it certainly amounts to thousands of dollars annually. Some idea of the loss may be gained when we consider the number of attempts that have been made to import animals into this State, or even change from one locality to another, that have ended in failure.

"Big-head" is known in veterinary literature as *osteoporosis.* It is very generally distributed over the State. Some localities of comparative small area, in the phosphate region, claim to be exempt. The term "big-head" is a misnomer description of a symptom of the disease and not of the disease itself. This has caused a misunderstanding on the part of many and been fruitful of much irrational treatment. Horses of all ages are subject to attacks, young horses succumbing more readily than the old. Those between the ages of three and six years, usually enlarge more about the face than those that are older. This can be accounted for by the fact that the teeth are in a very active growing condition at that period. The disease is sometimes confused with other diseases, as pus in the facial sinuses and caries of the teeth because these may also produce similar enlargements. Altogether too much stress is placed upon the enlargement of the bones of the face for the recognition of the disease and as being the essential point for attack in the treatment.

A careful study of the symptoms of the disease and the characteristics which differentiate it from other diseases has been made. The history of all cases that came under observation were taken in order to determine some of the probable causes. The pathology and treatment received as much attention as the cases at our disposal would permit. To determine the efficiency of certain remedies, a large number of cases will be necessary for experiments.

"Leeches" is recognized as *bursatti*. It has been chiefly reported by English veterinarians in India, but has received but very few notices in this country. This disease attacks animals that graze on low or marsh land, becoming more and more abundant as one proceeds southward. It is characterized by an indolent sore, exuding a thick serum, the tissue filled with little hardened nodules known as the "leech." The points of attack are the heel, legs, mouth, lips and breast—points most readily abraided. Such sores refuse to heal under the most careful and patient treatment.

The results of our work are not fully in accord with that of other workers in the matter of inoculation or treatment. A few more cases will be necessary to confirm or disapprove the work that has been done.

"Salt-sick" is a term applied to nearly all diseases to which bovine flesh is heir. It is to the stockmen of this State what "hollow-horn" is to those of some of the other States. The term does not mean the same in all parts of the State. In some localities it refers to animal parasitism, which is contracted by foraging over certain area. In other parts it is caused by animals grazing over drying lakes or swamps, in which the vegetation is unwholesome. A third cause is the eating of grass which has had sand washed upon it by dashing rains.

Respectfully submitted.

A. W. BITING,

Veterinarian.

E

Report of the Superintendent

DeFUNIAK SPRINGS SUB-STATION.

To Dr. O. Clute, Director,

The Superintendent of the DeFuniak Springs Sub-Station herewith submits his report for the year ending December 31st, 1893.

The Sub-Station owns forty acres of land near the city of DeFuniak Springs. It is piny woods land, of about the same quality as most of the lands in West Florida. Ten acres of this land have been cleared and cultivated.

There is a small four-room dwelling house for the Superintendent, which cost about $700, and a small frame barn, 16 by 20 foot, which cost about $125. The land and the buildings were a gift from some of the citizens of this county.

There are now in cultivation nineteen varieties of the peach, principally of the Oriental type. These early blooming varieties are frequently frosted in this climate and are not profitable. In the spring of 1893, fifty Elberta peach trees were planted. With these trees an experiment was made with fertilizers. Muriate and sulphate of potash, acid phosphate and nitrate of soda were applied. These fertilizers were applied singly, either two of them mixed, and the three mixed. Nothing was gained in wood growth where no nitrogen was applied. The fertilizers were applied on the surface, in a radius of four feet. There were two applications. The first application was on June 2d. In the thirty days following this application the trees made an average growth of ten inches. There was no marked difference of growth in the fertilized trees over that of the unfertilized. The second application of fertilizer was made July 3d. After this application, to the end of the season the trees treated with nitrate of soda added to the growth twelve inches and remained green until frost. These trees had twelve ounces of nitrate of soda at each application, that is, twenty-four ounces for the season. No other trees of this lot made any growth after July 1st.

There are thirteen varieties of pears, all doing well as to wood growth, except Idaho and Japan. Jefferson, Bartlett and Duchess bore a few fruit this year. Jefferson is a very handsome pear; ripe June 19th.

A variety of apricots and plums have been set. As yet there is nothing favorable to report concerning them.

Of farm products we grow a small field of cotton—"Matthews' Long Staple." It made a good growth and gave a fine yield. We think this desirable for upland long staple cotton. It has short joints, good sized boll, and shows no disposition to rust.

Of sugar cane we grew a small field of "Keni-Keni," a green variety, the seed of which came from the Sandwich Islands. It was planted on a sand hill, and at the time of planting was fertilized with 600 pounds of acid phosphate; at time of first working with 400 pounds of cotton seed meal, and at the second working with 200 pounds of nitrate of soda. It produced 63,000 pounds of green cane per acre.

A small plot of Cassava was planted on the same class of land. No fertilizer was used other than 600 pounds of acid phosphate per acre. It did well. This is without doubt a profitable root crop for this country, It requires but little cultivation, does not seem to be affected on the upland by the wet and dry seasons, yields from eight to fifteen tons of root per acre. All stock like the root, and thrive on the food.

A small plot was planted with tobacco, the seed from Cuba. It was fertilized with cotton seed meal, 200 pounds; sulphate of potash, 150 pounds; acid phosphate, 100 pounds per acre. It produced 500 pounds per acre. This is not a difficult crop to grow in this section.

During the year 1,166 cubic yards of ditch have been cut, and three-fourths of the fence been re-set. In addition to the fifty peach trees mentioned above, 100 Satsuma orange trees have been planted. The orange is doing well. It seems to be quite hardy in this climate and bears very early.

J. T. STUBBS,
Superintendent.

DeFuniak Springs, Fla., Jan. 8, 1894.

F

Report of Superintendent

BRANCH STATION AT FORT MYERS.

Director O. Clute,

The land of this branch station consists of twenty-five and one-half acres, half mile east of the city limits. It has about 1,000 feet of water front, on the south side of the Caloosahatchee Bay. The southern boundary is upon the most public road in Lee county. The buildings are one substantial frame barn, 20 by 40 feet, and 16 feet in the story, and necessary poultry and other out-buildings; a frame house 28 by 46 feet, one and a half story high, with two porches 8 by 24 feet. The house contains eight rooms, besides five closets. The buildings are all very well built, and cost complete about $1,900. The lands were procured at a cost of $50 per acre, $1,275. These lands and buildings, together with the fencing of ten acres, were furnished by Lee county and its citizens as their part of the stipulation to aid in permanently locating the branch station at Fort Myers.

For the year ending June 30th, 1891, there were $200 appropriated for this branch station outside of the Superintendent's salary of $800. This $200 was to cover all expenses for the year, including implements, feed, blacksmithing, labor, etc. For the year ending June 30, 1892, there were $500 appropriated to this station outside of the Superintendent's salary of $600. For the year ending June 30th, 1893, there were $1,400 appropriated to this station outside of the Superintendent's salary of $600. These appropriations of $2,100 for the three years were to include all expenditures upon the farm of every nature. It required rigid economy, in opening up a new farm, with these funds, where every laborer received the customary wages of $1.50 per day. Nearly one-half of the funds were required to purchase feed for the animals and all the various implements to operate the farm.

There have been about fourteen acres fenced and cleared, grubbing about forty cords of saw palmetto and other roots out of each acre, besides grubbing up the pine trees. About two acres have been enclosed with galvanized steel woven wire fencing as a protection against rabbits and other pests; also an acre for winter and summer garden has been enclosed with a similar fence. Two acres of ground have been thoroughly underdrained at a heavy outlay of labor and expense, to test the feasibility of summer gardening. Nine plats of pineapples have been planted with various kinds of fertilizers and different forms of cultivation. These experiments have developed large, vigorous plants, and large, delicious fruit, that are likely to invite their extensive cultivation in this part of Florida. Something over an acre of sisal hemp (*Agave rigida, var. sisalina*) has been planted, which promises to become a great industry in this part of the State. The orchard embraces seven acres of land planted in tropical and semi-tropical fruits. After preparing the land, the trees are set out 20 by 20 feet. The preparation for each tree is as follows: A hole, 4 by 4 feet and 4 feet deep, is dug, the top soil put on one side, the white sand is put on another side, and the hard pan on another, then a wagon load of muck put on the fourth side of the tree hole. After the hard pan and muck have been acted upon by the sun and air till they are pliable, the hole is filled up nearly full with the white sand and saw palmetto roots mixed. Then the top soil, hard pan and muck are mixed in and a bed formed six feet across and one foot above the level of the ground. After the rainy season has fully set in and the tree beds settled about all they will, the fruit tree is planted in the center of this bed, which should be done early enough to have the trees well started before the rainy season subsides in October.

There have not been sufficient funds here to experiment with the banana and plantain. These are such valuable food plants that it is important to use all means to encourage an extensive cultivation here. The cocoanut is being experimented with at the station with encouraging prospects. There seems to be no reason why there should not be enough cocoanuts produced in this part of Florida to supply the United States with all of its increasing demands for the future.

The Cahoon Palm, from Honduras, the most lovely ornament of all the palm family, is planted and growing nicely. The Sapodilla, one of our most delicious and profitable tropical fruits, is being experimented with and is doing nicely. The Mangosteen, probably the finest fruit known, has been planted but not with encouraging success. The Mango, admitted to be the finest fruit known except, possibly, the Mangosteen, is cultivated here with the most flattering prospects. The Mammæ Apple has been planted but not with encouraging success. It is a fine fruit and should be tested more fully.

The Mammæ Sapota is growing here but not giving satisfaction. The Cherimoya (*Anona Cherimolia*) is planted here and giving promising encouragement; a valuable fruit. The Star Apple, a rare tropical fruit, is planted and growing nicely. Seeds of coffee from Trinidad and Honduras have been planted but failed to germinate. The Barbadoes cherry has been planted, but the results are not encouraging.

The Date Palm (the date of commerce) has been planted with the best of prospects. The Spanish Lime (*Melicocca Bijuga*) is planted and doing well. It is a valuable fruit; not of the citrus family, but like an immense grape. The Sour Sop or ice cream fruit (*Anona muricata*) is planted and doing finely; a valuable and delicious fruit. The Bread fruit (*Artocarpus incisa*) has been planted but is not a success so far. The experiments should be continued, for it is a most valuable food fruit. The Melon Papaw or melon tree, (*Corica papaya*) produces fruit similar to a musk-melon. Perhaps nothing else is so valuable for dyspeptics and other invalids. It is planted and giving the greatest satisfaction. It will be largely cultivated in the future.

The Cashew-Nut (*Anacardium occidentale*) is planted and growing rapidly. The juice of the fruit is a delicious beverage, and the seeds are used in the place of almonds, and also a valuable Japan varnish is made from them. Experiments with this valuable tree should continue. The Tamarind (*Tamarindus Indica*) is planted here and doing well; it forms a large tree and is a prolific bearer.

Conserve of tamarinds is made from this fruit, which, when macerated with water and sugar, makes a delightful, most valuable, cooling febrifuse drink and appetizer for invalids. The Cacao (*Theobroma Cacao*) has been tried here, but the seed proved to be defective. From the seed of this tree chocolate is made. Honduras Sarsaparilla has been planted but failed to germinate. This valuable medical plant will receive further attention.

The Guava (*Psidium guaiva*). This valuable tropical fruit takes the place of apples and peaches both, and grows wild throughout Lee county. Experiments are conducted here to prove the best varieties. The Catley Guava (*Pridium Catleyanum*) is successfully cultivated here. It is a delicious fruit of easy cultivation. The Avocado Pear, (*Persea gratissima*), vulgarly called alligator pear, is cultivated at the station with the greatest success. This tree grows to a large size and the fruit is delicious and valuable. Its cultivation should be encouraged. The Bamboo is an ornamental and valuable plant which is planted on the station. It grows to the greatest perfection here, and there is no reason why we should import it from Japan to supply the factories in the northern cities.

Royal Palm. This exceedingly ornamental tree grows wild to a height of 150 feet in Lee county. It has been planted at the station. The India rubber tree is planted at the station. It grows splendidly in Fort Myers. Black pepper (*Piper nigrum*) is planted at the station and promises to become a valuable product. Its cultivation should be encouraged. Chinese Yam produces tubers which will weigh from one to thirty pounds, and when prepared for table use experts are puzzled to tell the difference between it and the Irish potato. It grows to perfection at the station, yielding at the rate of 600 bushels per acre.

The Cassava in South Florida is a perennial shrub, with tubers a little like a sweet potato. Will yield large returns in ten or twelve months from planting. A valuable human or stock food; the best known article for the manufacture of starch or glucose, and the only thing from which tapioca is made. The Royal Poincianna, one of the most beautiful flowering and shade trees, is growing at the station. It is conspicuous among the ornamental trees of Fort Myers. Wherever grown it attracts attention.

The Sugar apple is delicious fruit; perhaps it is the sweetest of all fruits. It is planted and doing well here. It should have a place in every collection for home use in this part of Florida. The Loquot or Japan plum is cultivated here and promises success. The Pecan is planted at the station. Pecans have ripened nuts in six years from the seed, in Fort Myers. It promises well in this section. The tropical or Otaheite Gooseberry (*Cicca distichia*) is planted at the station. It is a rampant grower, and forms a large tree in Fort Myers. The fruit is of the size and flavor of the northern gooseberry, and one tree will produce enough for a half dozen families. The Almond is planted here and promises to do well.

The above are among the tropical products being experimented with on this branch station. Some of them have not thus far succeeded. The failure has not been due to climatic influence in most cases, but to poor seed, cultivation, fertilizers, shade, etc. Contrary to what one would suppose, most of the tropical products require shade while young. A tropical climate is not always limited to the torrid zone. Some parts of the torrid zone have a severe winter climate, while some parts of the temperate zone, like the peninsula of Florida, with its water protection, have a tropical climate. There is an area of about 10,000 square miles in Florida with a tropical climate.

Lemons, limes, oranges, citrons, shaddock and other citrus fruits are cultivated here with complete success. The torrid zone is the home of the citrus fruits, and the nearer to it the more perfect the fruit. Many oranges and lemons are growing wild in this part of the State. Attention should be given to them, to determine the best varieties as well as best methods of cultivation. Grapes are cultivated here, and more attention ought to be devoted to them. Northern apples, peaches, pears, plums, quinces, etc., are experimented with here, but they appear to be out of their latitude, as they have not sufficient time for rest during the winter.

It is a noteworthy fact, that this part of Florida produces larger and finer pineapples, mangoes, avocado pears, sapodillas, guavas and other tropical fruits, than those grown in Cuba and other tropical countries. There must be some cause for this. Possibly it is due to the fact that our rainy and dry seasons are not so excessive as in most tropical countries. Secondly, our winters are cooler than in other tropical countries, giving more of a season of rest, after which plants grow off more vigorously, like northern products when spring returns. If a tree or plant is stunted by too much rain or drouth, it cannot come to its greatest perfection. We should give all the attention possible to tropical products here, as the most tender fruits that cannot be imported can in time be shipped North from here in the refrigerator cars.

L. C. WASHBURN, M. D.,

Superintendent.

Fort Myers, Fla., January 15, 1894.

NOV 1895

Bulletin No. 25. September, 1894.

FLORIDA
AGRICULTURAL EXPERIMENT
STATION.

LEECHES OR LEECHING.

(BURSATTEE.)

The Bulletins of this Station will be sent free to any address in Florida
upon application to the Director of the Experiment
Station, Lake City, Fla.

JACKSONVILLE, FLA.
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1895.

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LEECHES OR LEECHING.

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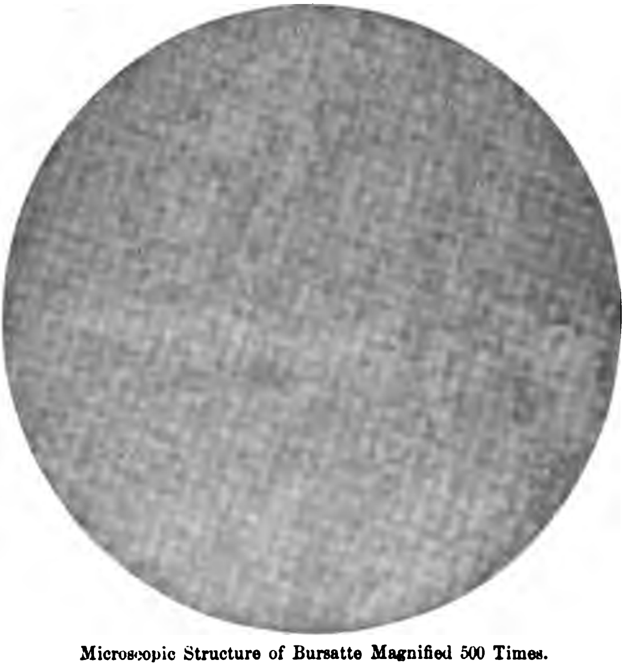
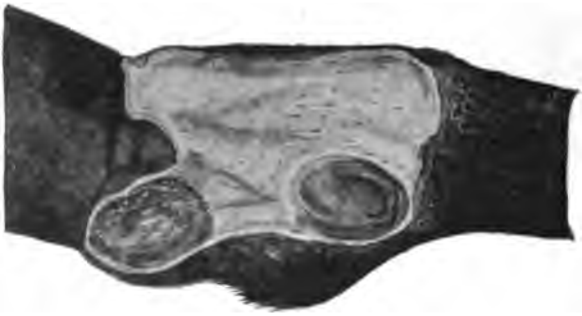
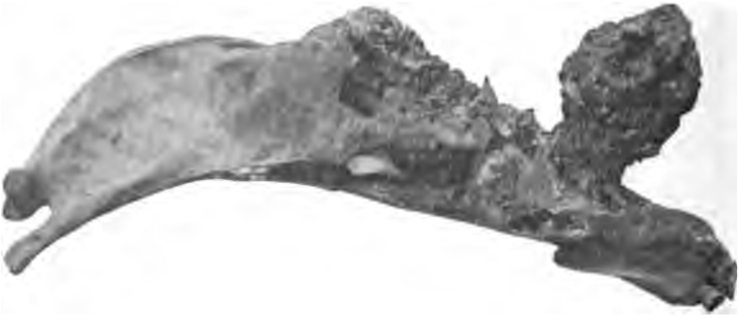
Microscopic Structure of Bursatte Magnified 500 Times.



Microscopic Structure of Bursatte Magnified 500 Times.



Typical Case of Bursatte.



Effect of Bursatte on Bone.

INTRODUCTION.

This bulletin, and bulletin 26, soon to follow, on "Big-head," represent in part the work done by Prof. A. W. Bitting during the time he was Veterinarian of the Florida Experiment Station. Unfortunately for Florida, he accepted a most attractive call to the position of Veterinarian of the Indiana Experiment Station, induced thereto by an unhampered field of work and a somewhat adequate salary. His work in Florida was necessarily left in an incomplete condition. In looking over the previous work of the Station, after my assumption of the duties as Director, my attention was called to the growing value to Florida of investigations of animal diseases by a trained Veterinarian, and I was led to write to Dr. Bitting in regard to frequently recurring questions as to such diseases. Learning that he felt a strong interest in carrying forward some of the work he had begun in this State, an offer was made to him to spend his summer vacation here in 1894. He accepted, conducted his work with vigor and enthusiasm and reported it to me in admirable shape. These two bulletins are a part of said report. Another bulletin on "Liver-fluke" will soon appear.

It will be seen that these bulletins give no infallible remedies. The quack doctor of men has cures for all the ills that flesh is heir to. The well-trained doctor of men knows that, in many cases, medical science has not yet discovered remedies for most serious diseases.

So the "hoss" doctor (whose decreasing shadow grows rapidly less), is always sure that he knows what ails every diseased animal, and that his "ile" is a sure cure. The educated doctor of animals knows that remedies have not yet been discovered for some of the most destructive diseases of his patients. He says this frankly, and gives his labor for years to careful experimentation, in the hope of discovering remedies.

While these bulletins give no "sure cure" of "Leeches" and "Big-head," they do contain in popular form the results of Dr. Bitting's valuable investigations of the diseases, which are the latest that have been made, and which have already received honorable recognition from the ablest students of Veterinary science. They throw much light on the subject, and clear the way for future investigations.

Dr. Bitting had most generous assistance and most hospitable reception from all to whom he applied or whom he met. Special acknowledgments are due to the Florida Central and Peninsular and the Jacksonville, Tampa and Key West Railroads for granting free transportation on all parts of their lines. It was through their liberality that the State was so thoroughly worked. Thirty-seven points in the State were visited; some only one time, but many of them several times. This required in all 3,126 miles of travel.

Through the kindness of the *Times-Union*, *The Florida Farmer and Fruit Grower* and *The Florida Agriculturist* the files of their papers were inspected for the literature concerning the diseases in this State. To Dr. N. B. Rhodes, of Tampa, and to Messrs. Smith & Pedrick, of Gainesville, thanks are due for assistance in securing material, and to Dr. J. C. Neal, Director of the Experiment Station at Stillwater, Oklahoma, for a record of the work he did when in Florida.

Recognition should be made, also, of the willingness of the Board of Trustees of the Florida Agricultural College to undertake this work, though they were hampered by serious financial limitations. Dr. Bitting's work much more than justifies the expense the Board incurred. It is very seldom that so much good work is done in so short a time and at so small an expense. This work is but a part of that which needs to be done to advance the stock interests of Florida. Many animal diseases need the constant study of an able Veterinarian. Among them may be mentioned: Southern Cattle Fever, Salt-sick, Blind Staggers, Rickets in Hogs, the East Coast Skin Disease, Cholera and Sore Head in Poultry, Ground Itch, Cattle Warts and Parasites. The field is a most important one, and needs the services of a competent man.

O. CLUTE,
Director Florida Experiment Station.

LAKE CITY, FLA., September, 1894.

LEECHES OR LEECHING.

(*Bursattee, Round-Celled Sarcoma.*)

BY A. W. BITTING, B. S.

There are in this State two diseases called Leeches: one an external affection of horses and cattle, the other an affection of the livers of cattle, produced by the invasion of a fluke (*Distoma hepatica*). This latter disease occurs in cattle grazing near the coast and along the rivers for some distance inland. While it is productive of no little loss, it is not generally recognized, and cattle men show but little interest in it. The term Leeches in this article will be confined exclusively to the external affection of horses, mules and cattle.

There is no definition in Veterinary literature descriptive of a disease known by our local terms Leeches or Leeching. The same disease is recognized, however, and is called †Bursattee, Bursati, Bursatte or Bursatti; the term being derived from the Indian word "Bursat," meaning rain. The term literally means rainsore, the appropriateness of which at once becomes apparent to stock men. The term Leeches is altogether a misnomer, and came from the belief that the sores were caused by the Water Leech. The term will be retained in this article for the reason that it will cause less confusion to the reader.

So little is known of the pathology of the disease, and so many conflicting views held as to the cause and nature, that a definition has not yet been formulated. The following will serve as a brief statement of its general characteristics. *Leeches is a non-contagious, malignant disease, characterized by an external sore, in which there are tissue changes involving the epithelium, connective tissue, muscles, tendons, bones or glands, associated with the development of bodies known as Leeches. The disease is slow in its progress, and has a tendency to recurrence during hot, damp weather.*

DISTRIBUTION OF THE DISEASE.

General Distribution.—The disease is not peculiar to this State, nor confined to "The Lake Region," as many suppose. It has long been known in India, was reported from Minnesota in *1886, Kansas and Alabama in ‡1889, and is now known all over the United States, except in that region lying east of the Alleghany Mountains and north of the Potomac River.§

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†Robertson's "Practice of Equine Medicine." pages 290-302.

*Lyford, Dr. C. C. The Veterinary Journal, May, 1886, pp. 378-381.

‡Anderson, Dr. John B. The Journal of Comparative Medicine and Surgery, June, 1889, pages 72-77.

The first published account of the disease in this State was by Dr. J. C. Neal in 1887.†

The Distribution In Florida.—There are probably few places in this State where the disease may not occur, but there are sections in which its occurrence is of much greater frequency than in others. The two northern tiers of counties, situated upon the high ground, suffer least. The regions that suffer most are those with numerous flat prairies and ponds. The section of country lying in the southern part of Alachua County, northern part of Marion County and extending southwestward across Levy County; the eastern portion of Citrus County; Hillsborough and Manatee Counties; the country lying west of the St. Lucie River and that around the head of the St. Johns River may be considered to furnish the greatest number of cases. A number of places may be found within these areas where the disease is very rare, and an equal number of places can be found in the northern counties where it is quite prevalent. If the State could be mapped into sections of high and low land the former would most nearly represent the area free from disease. I have seen the disease, or received information of its presence, at Lake City, Welborn; White Springs, Columbia, Lake Butler, Baldwin, Fort White, Gainsville, Arredondo, Wakahoota, Archer, Bronson, Rochelle, Micanopy, Anthony, Citra, Ocala, Iverness, Dade City, Plant City, Tampa, Miakka, Manatee, Palmetto, Tavares, Umatilla, Sanford, Orlando, Kissimmee, Osteen, St. Lucie River, DeLand, Belair, Apopka and Palatka. A glance at the map will show that the disease is very generally distributed. It is also fair to assume that the disease occurs at the intermediate points.

THE CONDITIONS FAVORABLE FOR THE DISEASE.

The disease occurs during the months of highest temperature, and particularly after the beginning of the rainy season. Heat and moisture, if they are not necessary factors, are certainly very prominent ones. An animal seldom suffers its first attack before the middle of June, but may at any time from that date until the middle of October. If the animal has had one attack and the sores apparently heal with the advent of cool weather, they may re-appear at any time after the first of April the following year. The months of July and August bring forth the greatest number of cases.

My own observation extends over a period of but three seasons, and hence I do not feel justified in making a statement concerning the influence of the season on the disease. The following is offered as the gist of statements given by many stock-raisers. While it does not apply equally well for all points in the State, it does to probably nine-tenths. A dry season is not favorable to the disease, as the ponds go dry. A season of excessive rainfall is not favorable, as the ponds then contain fresh water and will run from one basin to another. A season of moderate rainfall, so that the water only slightly rises or falls in the ponds or on prairies, is most favorable. Frequent showers succeeded by hot sunshine are particularly bad for horses on pasture.

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§Williams, Dr. W. L. Correspondence, October 2, 1894.

†Neal, Dr. J. C. The Florida Farmer and Fruit Grower, August 3, 1887.

Leeches most frequently attacks animals that graze upon low flat-woods or prairie. Here the animals stand for hours in water from a few inches to a foot or more in depth. The water in some ponds will cause the disease more readily than in others. Just what may be the difference between them has not been discovered. Dr. Neal thinks that "ponds with sandy shores are risky, and with black or muddy shores are safe." In a pond or prairie where an occasional horse will become affected, a cow will go free; one in which an occasional cow will become affected, almost any horse will become so diseased. A pond that will leech in July or August will be safe in December.

Ponds, prairies, flat-woods, pastures commonly thought to be the necessary influences under which an animal will leech, can only be regarded as the most favorable ones. It would be safe to estimate that seven out of ten cases do occur in such locations. The disease may attack an animal in upland pasture, and even in a bare lot or stable. A rainy season is not necessary, but is a condition which increases the number of cases and adds to the virulence of an attack.

POINTS OF ATTACK.

While leeches has no particular point of attack, yet it does occur on certain regions of the body with greater frequency than on others. The legs below the knees, the fetlocks, heels, feet, lips, breast and belly suffer most. Occasional cases occur in the eyes, the mouth, nose, sides of the face and neck, on the prepuce and mammæ. Dr. Neal says: "Leeching begins, usually, upon some part of the body that has been submerged." Mr. C. M. Smith, of Gainesville, a man of much experience in "cutting leeches," thinks: "It occurs most often on parts a few inches above the water-line." If we generalize from cases taken all over the State, it will be found that it makes no difference whether the part is submerged or not.

The disease may occur on one or more points of the body. The fact that it attacks the legs below the knees, the feet, lips, breast and belly, parts most readily abraded, has caused some to think that an injury or bruise serves as a nucleus for the development. An abrasion of the skin is not necessary, as observation has settled that point. That a bruise or similar injury is necessary is highly improbable. The large number of bruises produced accidentally, by the chafing of the collar and harness, and the wounds produced by an injury, and in surgery, the termination of which are known, admit of drawing the conclusion that these are not points of attack. In only one case have I seen leeches follow an accident, and in that instance the animal carried a foreign body in the wound for several months.

NATURE OF THE DISEASE.

Leeches affects horses, mules and cattle, the susceptibility of the animals being in the order given. Hogs, dogs, sheep, goats and poultry are exempt. It is generally regarded as being non-contagious. One affected animal may be in a lot with a number of others, free from disease, and none contract it. A mare may be affected and the colt not, or the colt may be affected and rub the diseased part over the dam without inducing it in the latter. The dam may lick the sore; dogs, hogs, cats and poultry may eat excised tissue with impunity. Men operate upon the disease without taking any extraordinary precautions. The possibility of producing it by inoculation has been denied. This has also been observed: leeches in the mouth or upon the lips is most frequently a secondary affection, and comes from gnawing the affected parts. If an animal has leeches on one part of the body, and some other part comes in contact with it—as one leg pressing against the other while at rest—there is a strong probability of a secondary attack in the part that comes in contact with that already diseased. During the summer of 1892 three cases were brought to the Experiment Station which showed this feature in a striking manner. On one animal a secondary growth was produced after numerous experiments.

SUSCEPTIBILITY AND IMMUNITY.

Some animals possess a certain resistive power so they are not readily attacked. Some never become affected, others not for ten or fifteen years, others in three or four years, and some animals cannot stand the effects of a pasture for more than a few days or a month. There are no characteristics indicating that an animal possesses this resistive power. After being attacked once, and successfully treated, the animal may never have another, or he may become much more susceptible; the latter result is more common.

I was able to obtain but few records to show the influence of heredity upon the disease. These were not complete, but the inference drawn was that it does have some effect. It may have been that the environment for successive generations made the offspring more susceptible. The point will not be urged with the present data.

As a general statement, a thick-skinned horse is less liable to be affected than a thin-skinned one.

THE CAUSE OF THE DISEASE.

There are many theories as to the cause of the disease. Some hold that a leech gets on the animal, enters the skin, deposits eggs, and these hatch and form the peculiar bodies known as leeches. Some believe a fly deposits eggs under the skin, and these develop and cause the sore. There are others who believe it to be due to a poison of some kind, to a fungus, and to a very small animal parasite.

Among pathologists the views held are no less confusing; animal parasites, fungi, fly bites, bruises and irritation have each had supporters.

Observation upon a number of cases may help settle a few points. In six cases animals became affected that had neither access to water nor pasture, which would eliminate the possibility of its being due to water or to the Water Leech. Its occurrence in the sole of the foot, and other parts of the body not accessible to flies would eliminate that factor. Animals become affected under divers forms of diet, so that poisoning from feed is eliminated as a cause. A microscopic examination of the tissue fails to reveal animal or vegetable parasites.

We are not prepared to state just what the cause may be. It certainly is not due to one thing, but the result of many. Furthermore, the local sore is not to be considered the only bodily disturbance.

SYMPTOMS AND CHARACTERISTICS OF THE DISEASE

The disease begins with a slight local swelling, heat and pain, a thickening of the skin and the tissues immediately beneath. The thickened portion gradually decreases from the center outward, but leaves a well-defined base. This outline may not be perceptible to the eye, but can be distinguished by the sense of touch. The whole is movable, and the skin may not be attached to the indurated part, or to but a small portion of it. In from two to ten days small spots like the pointing of an abscess may be seen. The hair falls out, and drops of yellowish, watery fluid exude. Across these points the skin will break, and a malignant sore is formed. The tissues are broken down, and all unite to form one open surface, which never extends beyond the indurated base. The edges of the skin turn back, leaving a decided mark between what seems to be the diseased tissue and what seems to be healthy. Such a division does not actually take place. Within the thickened tissue are formed the small bodies, called the Leech, or the Krunker, as they are known in India. At first they are very small, but begin to enlarge and attain the size of a pea, of a grain of corn, and even become half an inch in diameter. They are readily separated from the fibrous tissue and resemble a sandspur (burr of *Cenchrus tribuloides L.*). These so-called "Leeches" do not form altogether on the surface of the ulcer. They are found in all parts of the indurated base, and may extend back for several inches under the skin. They keep constantly forming around the ulcer, but slowly; the skin continues to break, and thus cause an extension or enlargement of the sore. On the surface of the sore several may apparently coalesce and form one large one.

There are two quite distinct forms of sores. In one the extension into surrounding tissue is slow. It is covered with a roughened surface which bleeds easily, but is not very sensitive. The Leeches are not abundant, and instead of becoming hard and gritty they remain rather small and soft. There is little pus formed, and this is often diluted with a watery fluid. The tissues vary from a bright red to a dull, livid hue. In the second form the same characteristics are present, but in a much exaggerated degree, the destruction of tissue being very rapid. The development of the Leeches is rapid and abundant. They become of large size, very hard and gritty. There is a special tendency to invade deep structures. Pus is formed in considerable quantity, and is foul-smelling. Associated with these symptoms is a rapid depletion of the system. The difference between the two forms is one of degree, as the first may at any time merge into the second if properly stimulated. Anything producing exhaustion or an unhealthy condition of the system will have a tendency to change a sore from the first to the second form. Local irritants will have a like effect. The following will illustrate how rapidly tissue is replaced in a sore of the second form: In an experiment, a section varying from one-fouth to one-half an inch in thickness, four inches wide and seven inches long was removed. In two days it was completely restored. Longitudinal incisions a half inch in depth, followed by an application of caustic potash, was next tried. The surface tissue sloughed off, but was completely restored in a week.

The primary lesion rarely breaks out in more than one point. Secondary lesion may occur at several places at the same time. If the disease is in the skin or mucous membrane, the greater will be the number of secondary sores. As many as eighteen have been observed on various parts of the body.

The affected parts may or may not project beyond the surface of the surrounding parts. Its tendency is inward. If over a bony structure, in a vascular organ or of an acute type, there is considerable swelling.

Leeches is peculiar in the manifestation of pain. At times there seems to be absence of sensibility, as shown by pressure, pricking, and even the possibility of excising portions without causing the animal to flinch. At other times the slightest touch will meet with resistance. There are periods when the animal gives little attention to the affected part, and other periods when he will gnaw or rub it incessantly if he can reach it. The irritation produced by rubbing, biting, the application of caustics or escharotics and excision of parts stimulate growth.

If the disease is situated in the skin or the tissues immediately beneath, the advent of cool weather may arrest it until the following spring. A few cases are reported to have completely recovered under such conditions. If the seat of attack is a gland or deep structure, there will be little cessation of activity.

The disease may involve the skin, mucous membrane, connective tissue, muscles, tendons, glands, invade joints and even destroy hoof and bone. A final result of an unarrested case of Leeches is death. A hoof or foot may be detached from a limb, the eye be eaten out, the tongue become so sore that food cannot be taken, or other organs so affected that the normal physiological functions cannot be performed. The length of time an animal can survive will depend upon how necessary the part is in maintaining life or how much it admits of exhausting the system.

R. W. Burk, F. R. C. V. S., of Cawnpore, India, in his contribution upon the disease, states that lesions occur upon the liver, spleen, intestines and other internal organs. In the three post mortem examinations in which the viscera were examined I failed to find anything present. The effect of the disease upon the body is that of depletion, especially if it is of the sloughing type. An animal may appear to be in perfect health when first attacked, but rapidly loses condition. There are periods of inquietude due to the pain or irritation, occasionally slight elevation of temperature for a few days, sometimes a cough, and not infrequently digestive disorders. As nearly all animals were seen after the disease had made some progress, the condition of the animals could not be noted in its earliest stage.

The disease posesses a marked tendency to recur after having been once enucleated, either at the same place or on other points of the body. This recurrence may occur the same year or after a lapse of a few years. There is always an element of uncertainty about the soundness of ananimal after the first attack.

Differential Diagnosis.—The disease may be confounded with a bloody wart, an unhealthy ulcer, and excessive granulations (proud flesh) in wounds of accidents or surgical operations. If a close examination discloses the absence of the characteristic body, "the Leech", the absence of "points" surrounding the open part from which a serous exudate escapes, and of the well-defined base extending back from the lips of the wound under the skin the case is not leeches.

MICROSCOPIC STRUCTURE.

The microscopic examination of the disease was made upon tissues taken from eight different subjects in all stages of development. Different processes were used for fixing, hardening and staining, to determine the presence or absence of animal parasites and fungi as well as tissue changes. No parasites were found except as accidental invaders. The tissue changes that are found to be present are such as are present in cancer. *Richard W. Burke. F. R. C. V. S., has called it Atropic Carcinoma. The following characteristics are present: a stroma of compact fibrous tissue between whose elements are seen numerous small, round cells. The fibers take an irregular direction so that a single section may present a longitudinal in one part of the field, a transverse in another, and the intermediate steps between the two. The cells between the fibers have no arrangement; they may be few or many squeezed together. The blood vessels are very numerous and irregularly disposed and of varying capacity. The walls are composed of round or elongated cells instead of those ordinarily found. The leech on section shows that it is a heterogenous mass, and has been built up by additions to the outside. A very thin section will not hold together. These Leeches or *Krunker* begin with a mass of round cells, and are the result of the squeezing of these cells together by the fibrous portion. In inflammation there is contraction of the tissue and they are the result. They may contain crystals of inorganic matter and pigment cells. The cells are of the embryonic type. According to the pathological characteristics it belongs to the *round-celled sarcoma*. It is a cancer.

TREATMENT.

During the summer of 1892 a case was brought to the Experiment Station for treatment, in which it was impossible to excise all the diseased tissue. An antiseptic treatment, consisting of washes of corrosive sublimate and carbolic acid and bandages of iodoform, was used. The disease made no improvement. An attempt was made to slough out the diseased part with dry arsenic. Fresh powder was dusted over the sore and bandaged every day for two weeks with the result of having a new growth twice the size of the original. Incising the tissue, and using caustic potash and zinc sulphate, made it worse. On various subjects solutions of copper sulphate, permanganate of potash, chloride of zinc, chloride of iron, and tincture of iodine were used without success. Dusting the surface with powdered calomel, sulphate of iron and alum, either alone or various combinations, did but little good. Iodide of potash, given internally in drachm doses twice a day for two weeks, repeated at an interval of an equal length of time, was tried in six cases. During the interval tonics were administered. The result was a large surface slough in two of which it made an operation easy. Extract of phytolacca produced no favorable effects. Various tonics were used in nearly all cases, such as Fowler's solution of arsenic, iron, quinine, nux vomica, gentian and such combinations as the symptoms might suggest. Of the local applications permanganate of potash was the best to prevent new growth. Some superficial sores healed with this treatment. A dressing of two parts of iodoform and one of calomel, and this covered with a coat of white lead, under a bandage, was of some benefit. Fresh dressings were used daily. Some have claimed good results with carbolic acid and a white lead dressing. In two experiments a hypordermic injection of equal parts ammonia, alcohol and water was used. This mixture was injected in small quantities all around and under the indurated part. The result was a sloughing of all the diseased parts, but the sore thus made did not heal readily. The number of trials were too limited to give it a recommendation. Dr. I. N. Huston, of Palmetto, Florida, in a letter to the Experiment Station in December, 1893, describes a similar method but uses kerosene. Many remedies were tried that were recommended by various parties who claimed to have used them successfully, but failed in my hands. The result of the work so far can not be said to be a success with medical treatment.

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*Burke, Richard W., F. R. C. V. S. Journal of Comparative Medicine and Surgery, Vol. vii., No. 4, October 1886, page 368.

Dr. Lyford says in his paper: "The treatment for my first year's experience with the disease was of an antiseptic and cleansing nature, but with little avail. The next year I tried caustics and irritants of all descriptions; actual cautery, arsenic, acids, nitrate of silver, also styptics, sulphate of iron and copper, tincture of iron, etc. The third year, iodoform, alum and salicylic acid with some indications of better results, but nothing flattering. For the past two years I have had excellent results with a liniment composed of olive oil, aqua ammonia and fluid extract of arnica; and a powder composed of alum, salicylic acid, calomel and sulphate of iron, and, as a rule, internal treatment by purgatives and tonics."

* R. W. Burke, F. R. C. V. S., says: "I have myself tried, in numerous cases, local applications of caustic potash, nitrate of silver, chloride of zinc, chlorate of potash, sulphate of copper, of iron and of zinc, salicylate of soda, salicylic, nitric, sulphuric, acetic and carbolic acids, myrrh, aloes, camphor, alum, sulphur, etc., without effect. Iodine and sulphurous acid injections have been latterly tried by myself in many private cases with equally useless results. T. Marriott, A. V. D., speaks very highly of the results of treatment by iodoform. Very extensive Barsatti growths on the fetlocks, lower lips and angles of the mouth have been gradually destroyed by caustics followed by iodoform dressings, and a healthy cicatrix has been obtained."

As cool weather has such a marked influence upon the disease, cold bandages have been suggested. No trial of ice was made. In one case in which a gentleman did try such applications he found that it allayed the irritability but did no more.

There is one method of treating the disease that may be considered a success: that is, by excision. This method can not be used in all cases and has met with some disapproval. Opposed to all theories and beliefs, there are hundreds of animals in the State that have been so treated and are sound. The success of the operation depends upon the thoroughness with which the diseased tissue has been removed. As long as there is a single leech left, so long we have sufficient tissue left to start a new growth. In all cases it must be remembered that the diseased tissue extends to the boundaries of the indurated portion, which may be several inches from the open sore. The cautery is not necessary, but is used as a means of destroying possible traces that have escaped the knife and to arrest hemorrhage. The disease has a special tendency to recur in the wound after an operation, and the failures are largely due to taking too little tissue.

The experiments in treatment at this Station were made before the necessary appliances for making a microscopic study were available. With the additional light which such a study has thrown upon the disease excision should be the means of treatment, and that in an early period.

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*Burke, Richard W., F. R. C. V. S. Journal of Comparative Medicine and Surgery, Vol. viii, No. 2, 1887.

3 NOV 1895

Bulletin No. 26. **October, 1894.**

FLORIDA

AGRICULTURAL EXPERIMENT

STATION.

BIG-HEAD.

(OSTEO-POROSIS.)

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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1895.

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BIG-HEAD.

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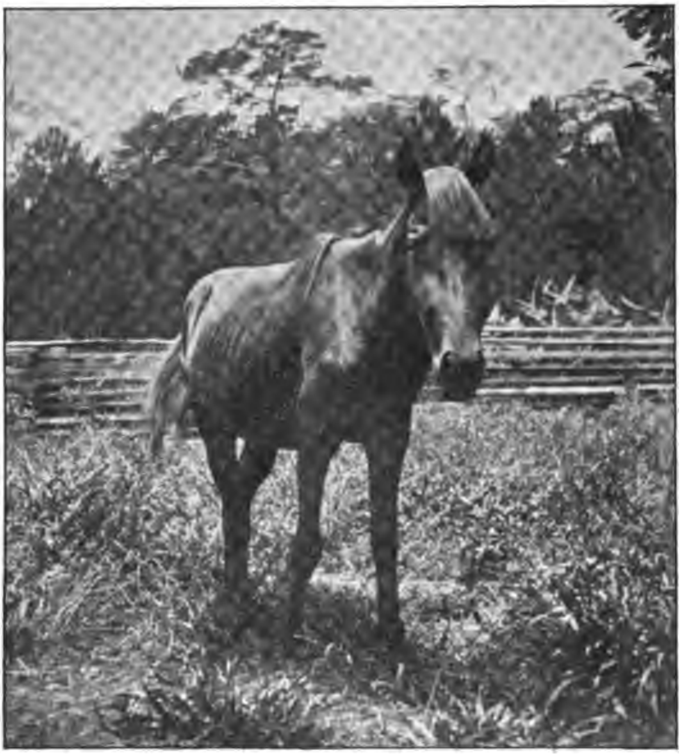

Fig. 1.

Fig. 1.—This is a typical case of *Osteo Porosis*, or Big Head, in a two-year-old colt. The bones of the face, lower jaw, and shoulder are greatly enlarged. The body has changed from a round barrel to a very flat-sided shape. The back is arched upward.

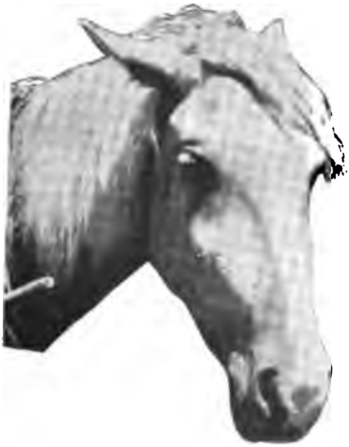

Fig. 2.

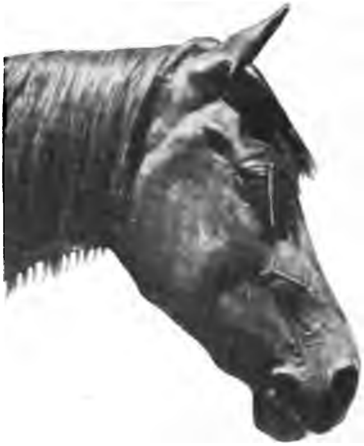

Fig. 3.

Fig. 2.—This cut shows the rounded condition of the face, due to enlargement of the bones of the face. The subject is five years old, and in the early stage of the disease when photographed.

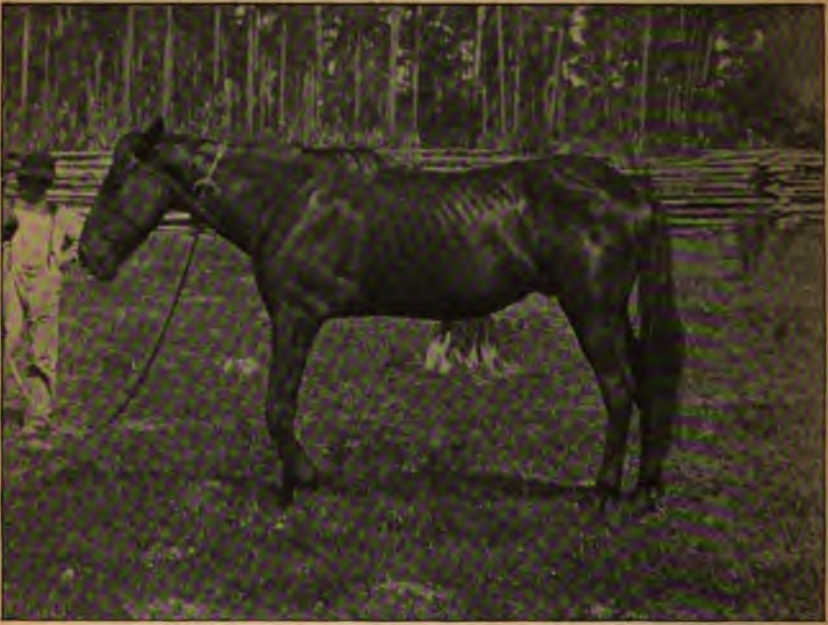

Fig. 4.

Fig. 4.—Shows the effects of the disease upon the bones of the leg while young. Both fore legs are crooked and not flexed. The animal made a recovery, and had a second attack at nine, producing an increased enlargement of the lower jaw and shoulder. Photographed at ten.

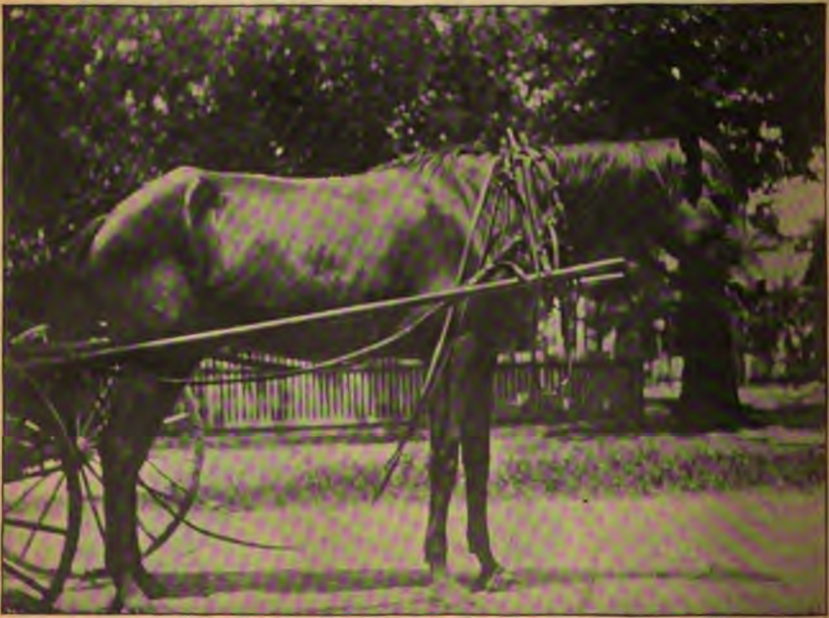

Fig. 5.

Fig. 5.—Shows the characteristic drop of the croup and a straight back.

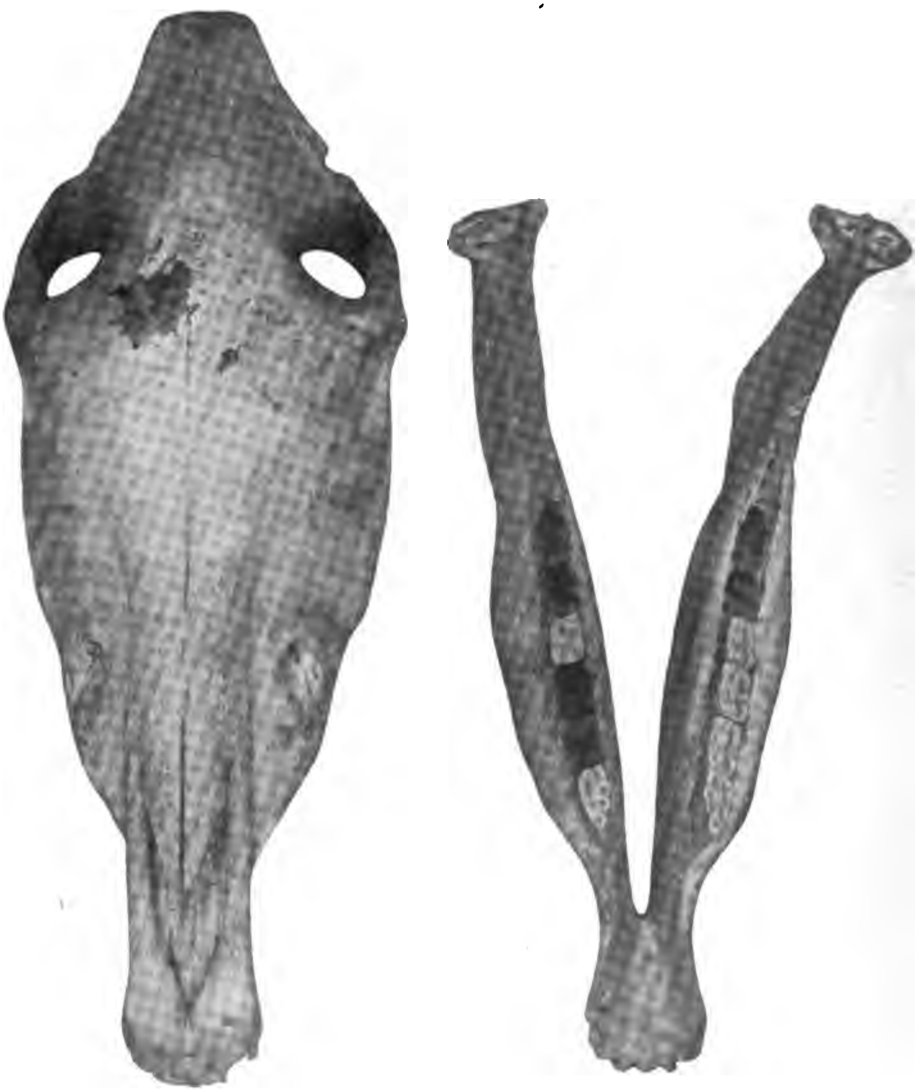

Fig. 6. (6 years old.)

Fig. 6.—Represents the bones of the head of a six-year-old horse affected with the disease.

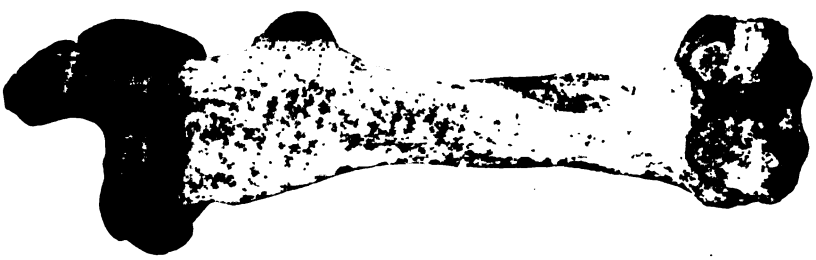

Fig. 7.

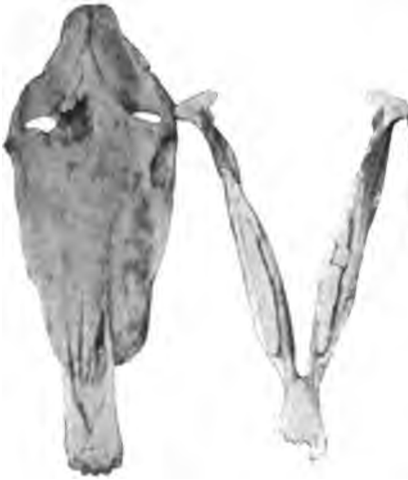

Fig. 8. (8 years old.)

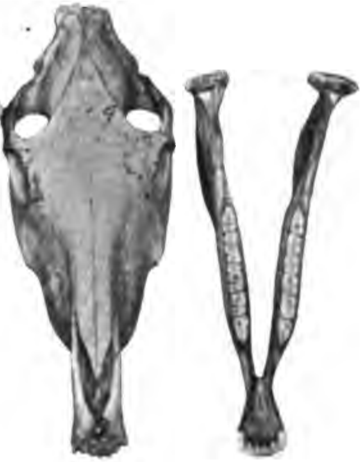

Fig. 9. (9 years old.)

Fig. 8.—Represents the bones of an eight-year-old animal.
Fig. 9.—Represents the bones of a nine-year-old animal affected with big shoulder.

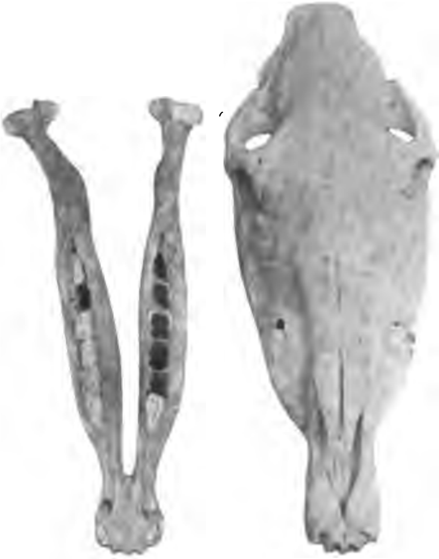

Fig. 10. (4 years old.)

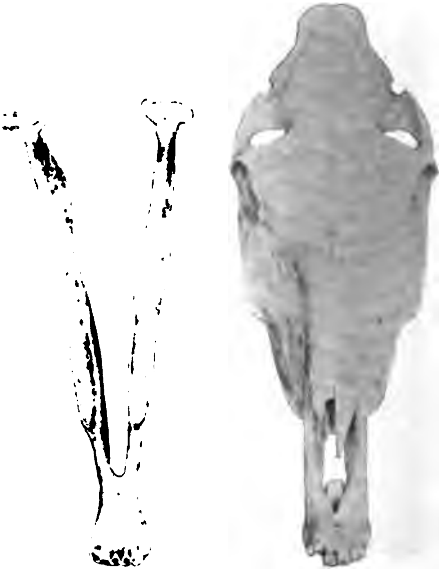

Fig. 11. (Healthy.)

Fig. 10.—Represents the bones of a 4-year-old horse.
Fig. 11.—Represents the head bones of a healthy horse.

BIG-HEAD.

BY A. W. BITTING, B. S.

OSTEO-POROSIS is a disease that is commonly called Big-head or Big-shoulder. These two terms have been used because they are expressive of very prominent symptoms. Big-head is used when the bones of the face and lower jaw become very prominent. Big-shoulder is used when the shoulder is the seat of the affection. In a very few instances the term Big-stifle has been used. The majority of those that use these terms are not aware that they are being applied to the same disease.

The term *Osteo-porosis* literally means porous bone, and is descriptive of a condition that exists in the bones of an affected animal. Big-head is the most common form of the disease. To avoid confusion of terms this one will be retained throughout this bulletin. It will be used to embrace Big-shoulder and Big-stifle.

HISTORY AND DISTRIBUTION.

The first account of the disease published in English was by Varnell, in England, in 1860. It would therefore appear that the disease has not been recognized, or not understood, for a very long time. Since that date numerous articles have appeared upon the subject. The earliest account that appeared in this State relative to the disease was in the *Florida Agriculturist*, Vol. 1, page 2, May 15, 1878. It is there described under the term *Osteo Sarcoma*. Several articles have been written by local observers, especially for the agricultural columns of the *Times-Union*. By inquiry it was learned, from the oldest residents, that they could not remember a time when the disease was not present.

The disease is very widely distributed, occurring in nearly all parts of this country and in foreign countries. It is found under all climatic, soil, and food conditions, and, therefore, cannot be due to any one local cause. It is not uniformly distributed, being of very rare occurence in some places, and altogether too common in others. This can be as truly said of the disease in this State as in the country as a whole.

The disease is one that interests a large proportion of the horse raisers and importers of horses in the State. I have seen cases, or received reports of the disease, from the following points: Milton, Carrabelle, Tallahassee, Monticello, Live Oak, Welborn, White Springs, Lake City, Baldwin, Fort White, Gainesville, Arredonda, Archer, Churchill, Citra, Anthony, Ocala, Floral City, Tampa, Palmetto, Miakka, Bartow, Grand Island, Eustis, Umatilla, Sanford, Paola, Belair, Maitland, Apopka, Orlando, Oviedo, Kissimmee, Narcoossee, Titusville, Sand Point, Palatka, Ponce deLeon, DeLand and Mannville.

It will be seen by looking on a map of the State that it has a very general distribution. Some parts of the State were not visited, which may account for not having more complete data. At some of these places the disease is very rarely seen, while at others the conditions for its development are so favorable that no attempt is made to rear colts. It will be seen, also, that it occurs upon the highest as well as the lowest lands, where hard water is obtainable as well as where soft water is used; in fact, it may occur under every condition in the State.

NATURE OF THE DISEASE.

Big-head is generally regarded as affecting only horses and mules. Whether other animals are or are not sometimes affected, might be open to controversy. As young cattle, hogs and dogs are occasionally afflicted with Rickets, it would be well to compare their symptoms and the bones of their carcasses.

Big-head may attack horses or mules of any breed and at any age. Young animals are more susceptible than old ones. In the older animals—past eight—if they are accustomed to hard or jerky work, it may assume the form called Big-shoulder. Mules are less susceptible to the disease than horses, and the termination is more favorable.

By some Big-head or Big-shoulder is regarded as a local disease, and they treat it as such; in fact, such belief is quite general. Although some cases do have the appearance of being localized, it would be better to assume that all the phenomena could not be seen rather than to pass judgment that it was local. Of the large number examined, but few have presented only local symptoms. The local enlargement may be all that can be seen at one time, but at another or later other symptoms will be present.

The following, from the *Times-Union*, is fairly representative of the views held by stock men as to the cause and nature of the disease:

"Big-head is caused nine times out of ten by blind teeth. These are superfluous teeth that appear just in front of the upper jaw teeth, and are in appearance like the bridle teeth (so-called) that appear between the jaw teeth and the front teeth. They penetrate the nerves of the eye and face, and cause Big-head. Big-head occurs in two forms: one as an enlargement just under the eye, just over the blind tooth. The other as a peripatetic lameness, which appears in one leg today, and another at another time, and goes from one leg without apparent cause. This form is accompanied by general constitutional disturbance, dejection and poverty.

"The first step in either case is to extract the blind teeth. If the enlargements have appeared under the eyes, let them alone for a few months; they will often disappear in a few months after the teeth have been extracted. If they do not disappear, but form abscesses, cut into the abscess through the thin bone and inject tincture of iodine into the orifice as long as it can be kept open." * * * *

Several definitions have been formulated descriptive of the disease so far as it pertains to the effects upon the system. They do not agree in every particular. *Williams says: "The disease is due to the development of the vascular and fibrous structure of the bones without a corresponding growth of the true osseous and cartilaginous elements."

†Rochitansky defines it as follows: "Osteo-porosis consists of the excessive development of the tissues which occupy the canals and cells of bones; whilst at the same time the quantity of bony matter remains unchanged.

---

*The Principles and Practice of Veterinary Surgery, p. 195.
†Ibid.

††"Osteo-porosis is an absorption of the interstitial elements of the bone." The last definition comes more nearly being a correct statement than those preceding.

IS THE DISEASE CONTAGIOUS?

This is one of the first questions asked when called upon for advice. No experiments have been conducted to settle this question. As far as possible, the history of each case was taken, and from these the following will serve to illustrate the various conditions under which it has occurred:

In stables at logging camps and phosphate mines one or two horses out of fifty to one hundred head would be affected and others never contract the disease.

Diseased animals are constantly being driven to the villages, where they are tied to racks with other horses. No other animal may contract the disease.

Colts and adult animals may become affected although always having been isolated from other animals of their own species.

After one horse suffering from the disease has been introduced upon the farm, others have taken it where all had previously been healthy. On one farm the disease was introduced in 1888, and has remained there ever since. Nine horses and mules have died, three have been given away, and two have the disease now. Recruits become affected soon after being taken there. No difference could be detected between this place and others in the vicinity, except that everything was in better condition. The disease had never been known prior to 1888.

Four horses died successively in one barn. It burned; a new one was built some distance from where the old one stood. No animals have died since.

After one outbreak on a farm there seems to be greater danger of a second following.

Sometimes the disease assumes an enzo-otic form, several horses on the same farm or neighborhood becoming affected.

When the disease does occur as an enzootic it runs a more uniform course than in the sporadic cases; recovery or death being the termination in from two to five months. Three such outbreaks were observed. Eleven animals in the same vicinity being affected in one summer, in the first; eight, and seven in the second and third respectively.

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††Dunglison's Medical Dictionary.

The fact that the question of its contagiousness is so often asked is indicative of a suspicion that it is. The evidence is not conclusive to prove either side.

TRANSMISSION BY HEREDITY.

But few facts could be obtained to determine whether the disease, or a predisposition to the disease, could be transmitted by heredity. These, however, are of considerable importance.

A Kentucky-bred stallion was imported at the age of two years. He became diseased and recovered at four years. The bones of his face remained permanently enlarged, but nót unsightly. He was used for ten successive years, and so far as known none of his colts were ever affected. He again became affected at the age of fourteen. If he should ever be able to beeed again the result will be watched with much interest.

A colt died with the disease at the age of eighteen months. The sire had only recently recovered from an attack. No further information was obtainable regarding his get.

In another case the sire was diseased and died. One of his colts had the disease and died at two, another at three years, and two others have the disease, but are still alive.

In an importation of seventeen mares fourteen became affected and died before the end of three years. Every colt they produced is believed to be dead.

In three cases, where the mares were affected and died, the colts have been affected and two died. The disease may be present at birth or occur in a year or two after.

In view of these facts, it must appear unwise to use animals for breeding purposes that have onee been affected.

SUSCEPTIBILITY AND IMMUNITY.

There is little difference as to the susceptibility of native and imported stock. Some affirm that none but native animals are ever affected, and others are equally as certain that only imported animals suffer. Native horses suffer from the disease at an early age—usually under six years—and as colts, under three. Imported horses become affected in from one to three years after arriving. Those brought from the

Southwestern States suffer more than those brought from Northern Tennessee and Kentucky.

A horse under eight is more susceptible than one over that age. One with a large, loose bone less resistive than one with hard, smooth bones.

One attack does not confer immunity against another.

No animal can be said to be immune to the disease.

CAUSE.

The cause of the disease is generally said to be idiopathic or unknown. It is attributed to a malassimilation of food, the nature of which is not understood. This might serve to explain some cases, but will hardly be found satisfactory for all. Where the disease is slow in its progress, or occurs with the development of the body, such might answer. When it occurs as an enzo-otic, several animals being affected simultaneously and under different conditions, and the disease acute in its nature, it does not seem to be sufficient. A better explanation cannot be offered here.

Lack of lime salts is often offered as a cause. There seems to be good reason for this, and yet the disease is found in those parts of the State where animals have access to lime water as well as in the other where only soft water is obtainable. In one locality every attempt to raise a colt has resulted in failure.

A team of imported carriage horses was fed on imported hay and grain, yet became affected.

With the digging of deep wells thus avoiding the surface water, which always contains much organic matter, there is believed to be a decrease of the disease.

As blind teeth are so often held to be the cause of the disease, and are the objective point of so much treatment, inquiry was directed toward finding the proportion of affected animals that possessed these bodies, and thus dissuade some from inflicting unnecessary and useless pain upon their beasts. Of twenty-eight cases examined for these teeth eleven were found to be without them. Neither did the extraction of the teeth have any appreciable effect upon the course of the disease.

SYMPTOMS AND CHARACTERISTICS.

The disease presents itself under such a variety of forms that the symptoms of any one case will not serve for all. The disease may be very insidious in its attack and mild in nature, or it may be very acute and rapidly fatal. One of the first symptoms noticeable is the dropping of the croup. This becomes more and more marked as the disease advances. It is usually a symptom that goes unobserved by most people. Following this is weakness of the back and enlargement of the bones of the face or lower jaw, when it assumes the form of Big-head, or of the shoulder, when it is known as Big-shoulder. Excessive development may occur in one or all of these bones at the same time. Other bones may show thickening or excessive roughness. The ribs gradually change so that a round-barreled horse becomes flat-sided and a tendency to hang heavy below. The back becomes straight, and the younger the animal the greater the tendency to become elevated or arched.

Simultaneously with these bony changes are other symptoms, some of them much more apparent to the eye. A peculiar lameness precedes or accompanies all the processes. The lameness comes on very suddenly, at first very difficult to locate, appearing at one time to be in one joint, and found in another when an examination is made. There is no heat, swelling or pain over any part to locate it. We simply know the animal is lame. The lameness is of a very migratory character, being in one limb one day and in another the next. The lameness ceases as quickly as it comes. The animal assumes a very peculiar gait. There is little shoulder movement, the steps are short, executed as if there was stiffness in all the joints; the hind legs are carried further under the body than natural, thus giving the appearance of kidney trouble. Many poor animals are made to suffer from drenches for kidney disease and blisters over the back as the result of a mistaken diagnosis.

In the milder forms the appetite remains about normal, and the animal is capable of doing fair work. In other cases the appetite persists, but the animal is incapacitated for work. The general condition remains fair until after the disease has made severe inroads in the bony system. Decline then begins and is rapid. The temperature in the mild form is from 100.5 to 102 degrees. The pulse and respirations are normal. The animal can be easily exhausted on work that ordinarily would be light.

The disease often abates in activity for several days, weeks or even a couple of months or more. This seems to be the tendency in most cases, and gives rise to reports of cures that are without foundation. Some of those who make a business of treating the disease take advantage of this, and return the animal to the owner at an opportune time to make a good fee.

In acute cases these symptoms are more severe and follow each other in rapid succession.†

In the enzo-otic outbreaks the disease may attack some of the animals very feebly and only partially discommode them for a month.

One attack does not confer immunity from a second.

POST MORTEM.

The bones, or part of them, are found to be enlarged and cancellated. The hard surface gives way to small, roughened, brittle eminences. The large bones are more affected than the solid, compact ones, yet the latter do not wholly escape. The hard layer on the outside becomes channeled out until it is but little stronger than the inner part. The heads become very spongy, in many instances separate from the shafts. The articular surface of the vertebræ may separate from the body. The sutures in the head become more open, so that in a horse of five or six they may show as well as in a colt of three or four months. The marrow of the bone becomes changed from a bright pink to a duller, yellowish-red hue. In consistency it resembles albumen, and when the bone is sectioned it comes out as if under pressure. There is little or no fat in the bone, although there may be considerable in other parts of the body. This becomes very evident when the bones are permitted to bleach in the weather. The mineral elements are reduced in quantity. The cartilages over the articular surfaces may be involved, and either reduced in thickness or completely worn away. The inter-articular ligaments are abnormally developed, especially in the small of the back (lumbar region.) The roughening of the bony surface seems to be largely for the purpose of giving them additional support. The ribs, in long continued cases, approach a cylindrical form. The cranium is not involved except in young animals. In these the bones may thicken unevenly and produce strange mental manifestations. They may also bulge forward, as in cases of hydrocephalus. Roughening of the neural canal has also been observed. Tendons sometimes break from their attachments.

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†There is soreness and often swelling of the joints and inability to get up or lie down. The temperature often rises to 103 or 104 degrees F. Loss of appetite and emaciation follow. Fracture of the bones is very easy. In one case seventeen ribs were fractured in lying down. Death is nearly always the termination.

Fractures tend to heal with more rapidity than in healthy bone.

The blood, liver, kidneys, spleen, and other glands of the body were studied, but nothing that could be considered characteristic of the disease was found.

Analysis of the urine to determine the escape of mineral salts was only given a brief test. The indications are that the escape of such salts in mild cases, if they do escape by the kidneys, is too slow to make an appreciable difference.

The most noticeable change was in the large quantity of albumen that was present. During the course of the disease the urine is but little affected in color, odor or quantity.

In acute cases the urine becomes so modified by the fever and other constitutional disturbances that analysis of it was of little value. Furthermore, the variations in normal urine may be as great as in that of the diseased subject.

While the greater part of the work upon this disease was in progress the Station was not equipped for making a study to determine the presence or absence of bacteria. Only in the last animal that was killed was such a study possible. Bacteria were found in the jaw, shoulder (Humerus), ribs and vertebræ. Whether this presence was accidental (due to any other diseased condition of the body), or peculiar to this disease, could not be determined. Only future study can tell. Although a germ theory is not held concerning this disease, it is well worth investigating.

Big-head is sometimes confounded with other diseases. Not every case of obscure lameness is due to Big-head. Enlargement over the face may be temporary and occur at dentition, or be due to a diseased tooth. This can be told by a careful examination of the teeth. Rheumatism is similar to Big-head in its attack, and in its disappearance from one part of the body to occur in another. In Rheumatism there is always local evidence of the disease. A weak back may result from many causes. It is only by making a close study of all the symptoms of Big-head that a differentiation can be made between it and other diseases.

TREATMENT.

We are not prepared to offer a treatment that can be considered a cure. If it has been shown with sufficient clearness that the disease is not local but general, and that a treatment which has for its end a local effect will not be sufficient, something has been accomplished. The boring of holes in the side of the face or jaw, filling them with arsenic, iodine, caustic potash, or applying a hot iron, can have but a local effect upon the disease. They can produce intense pain and suffering. These remedies, with the knocking out of teeth, and setons are the means used by "Big-head" doctors. Some horses do make a temporary recovery and a cure is reported. The change of feed, attention, better care and rest are more potent factors in bringing this about than the treatment. This intermittent character or abatement of active changes may occur in any case. As a rule, it is only of short duration. Big-head will probably make most improvement by turning out to pasture, if the pasture is good, and allowing rest for five or six months. This should be supplemented with a liberal supply of lime, or lime water (hard water.) The lime can be administered in the form of lime water by dissolving a few lumps in a barrel. The water, if not stirred or shaken, will only contain a certain amount, and may be used without doing any harm. If it is stirred or shaken it will hold an excess in suspension and cause alkalinity of the stomach and irritation of the mucous membranes. The most successful means of administering the lime is in the form of the dicalsic phosphate. This can be obtained as a fertilizer, and is made from bones, such as used at glue factories, treated with lime water. An example of such fertilizer is Banner Bone, made by the Michigan Carbon Works. It is inexpensive as compared with calcium phosphate that is sold at drug stores for such purpose. It is neutral, readily soluble in the juices of the stomach, and can be given with the food. One or two tablespoonfuls a day will be sufficient. There is no danger of an overdose, but trouble in the kidneys or bladder might arise if more is administered. It is a fine powder and odorless and tasteless, so that stock will eat it willingly with other food.

Over the enlarged bones of the face spirits of turpentine or a very mild blister may be applied occasionally.

The feed should consist of oats and bran as the concentrated feed in the place of corn. Root crops can be used to good advantage.

For imported horses more care should be given to them for the first two years than is ordinarily bestowed. The practice of importing the horses to handle the tourist trade in the winter, and then selling them to work in the groves as soon as that business is over, is putting them to work that is too severe at a time when they are not acclimated. If they could be given a little less work the first year they would fare much better.

The use of water from a deep well, instead of from lakes or open holes six or eight feet deep (erroneously called wells), is advisable as a preventive measure against this disease as well as many others.

No animal that once becomes affected ever wholly recovers from the effects.

Avoid purchasing horses with coarse bones or naturally rounded faces.

Better save your money, and not invest in prescriptions or patent preparations.

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Bulletin No. 27. November, 1894.

FLORIDA
AGRICULTURAL EXPERIMENT
STATION.

NOTES ON EXPERIMENTS
WITH THE
PINEAPPLE.

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1895.

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Prickly Cayenne and Red Spanish Pine-Apples.

INTRODUCTION.

It is the duty of an experimenter to record and publish the result of his work, without regard to the opinions or methods which others may hold or follow. When the experimenter has been able to carry on but a few experiments, for only a few years, and under local conditions which may not prevail elsewhere, his conclusions will not always be found to correspond with conclusions which may be reached by him, or others, after wider experience.

Able men differ in regard to many things. They differ in regard to the cultivation of pineapples. Some successful growers pursue methods as to planting, fertilizing, and applications of remedies, which differ from those pursued by Dr. Washburn. As to which methods are best, further and wider experience must decide. Dr. Washburn can only state what he has done, and the results attained, hoping thus to give a contribution of some value in the final determination of the questions involved.

Some delay in printing this bulletin enables me to say that the experience at Fort Myers, in the disastrous winter through which we have just passed, has been most encouraging. The young pines, which had been set in the open ground only a few weeks, or three or four months, were not seriously injured. The pines a year or more old were injured about 33 per cent., the plants being so frozen as to soften and decay. The other two-thirds of the old pines are looking well, are now blooming, and promise a good crop in '95. Young pines in an ordinary pineapple shed, made of three-inch strips, came through in very fine condition.

The combined effects of the freeze of December, '94, and of that of February, '95, did not seriously injure citrus fruits. The trees did not lose their leaves; many of them are now in bloom, and others will bloom soon; all promise a large crop the present year. Much fine fruit has been shipped from there since December. At the Orlando fair, March 19–22, all visitors had a chance to see the large display of citrus fruits and of vegetables made by Lee county, in charge of a gentleman from Fort Myers. Many of the guavas are sprouting from branches four to six feet from the ground; the Avocado pears (alligator pears) are sprouting from heights of ten, fifteen, and even twenty feet; the mangoes are growing luxuriantly, and will give a crop in '96; and the cocoanuts are growing and blooming.

O. CLUTE.

Lake City, March 30, 1895.

NOTES ON EXPERIMENTS WITH THE PINEAPPLE.

On my own ground and on the grounds of the Experiment Station at Fort Myers, Fla., I have grown the pineapple (*Ananassa sativa*) for nine years. In January, 1891, I began some experiments to test the value of varieties, and the cultivation and fertilization best suited to this fruit.

SOIL.

The land planted was the common pine and saw palmetto land, or "flat-woods land," of South Florida, of rather poor quality, having a large portion of silica and humus at the surface, and underlaid at the depth of one to two feet with a stiff hard-pan, which effectually prevents leaching. The land had been cleared of pine trees and palmetto about two years before, and had been under cultivation for that length of time. It lies a few rods from the water on the south bank of the Caloosahatchie Bay, a mile and a quarter east of Fort Myers courthouse.

CLIMATE.

The climate is, apparently, well adapted to this fruit. The temperature rarely rises above 90 degrees in the summer, or falls below 40 degrees in the winter, but occasionally there is a frost. It will be seen that, in the winter of 1893–94, we had frost sufficient to injure pineapples that were mulched, though pines not mulched, on beds adjoining, were uninjured.

Throughout the summer season, the rains are frequent and copious; but in the winter the rains are much less frequent, though we have always had enough to keep the pines in a thrifty condition.

SETTING OUT PLANTS.

When I began cultivating pines nine years ago, I carefully followed the advice, given by some able growers, to pull the leaves off from near the bottom of the suckers and slips, and to cut off the lower end or hard part, before planting. But I soon became convinced that the plants needed to be firmly set in the ground, so I adopted the method of not trimming them at all, but opened the ground wide, and planted the slips about three inches deep, and the suckers about six inches deep, covering over the lower leaves and tramping the soil firmly upon them. I found that plants so treated grew off more rapidly, and made stronger stalks and larger fruit than did those plants which were trimmed.

The pineapple is a surface feeder, sending out lateral roots from the spaces just above the lower leaves of the slips or suckers, hence when those leaves are spread out and covered firmly, they become a support to the young plant and no impediment to the starting or the growing of the roots. This method saves quite an amount of labor and expense.

FERTILIZERS.

The pineapple is a voracious feeder. It requires heavy fertilizing. Nitrogen, phosphoric acid and potash are all required in generous amounts. Perhaps the following manures are the best sources from which to obtain these requirements: Poultry manure, stable manure, guano, blood and bone, bone meal, cottonseed meal, acid phosphate, sulphate of potash; and well-rotted muck. If compost is used, it should be well-rotted and ready for assimilation. Compost, undergoing fermentation, will destroy the feeder roots. Pine lands, containing much silica and vegetable mould, are the best for this fruit, especially if there is a good foundation to prevent leaching away of fertilizers and moisture.

CULTIVATION.

Clean cultivating is best, with a scuffle hoe, being careful not to cut the feeder roots, which are found one to two inches below the surface. Mulching is a disadvantage, for while the mulched plants are green and thrifty, they are too susceptible to frost. If planted in well pulverized rich soil, 18 by 18 inches, the plants will protect each other, and prevent the fruit from falling over to get sun-burned.

When planted close together, the leaves stand more erect, and become a partial shade for the fruit during a part of the day, which is an advantage. If set close together, they only require cultivating the first year, as the plants monopolize the ground and keep other vegetation down when one year old. I find, too, that pines are just as large from plants set 18 inches by 18 inches as from plants set four feet each way. I would plant closer rather than farther apart. With the pineapple, as with everything else, the less injury to the foliage the better. In cultivating, I step on top of the leaves, as bending them down does no great amount of harm, while striking a leaf sideways is likely to tear it loose and injure the stalk. In fertilizing a plat, I mix the fertilizers well and sow over the plants, like sowing oats broadcast, and let the dew and rains dissolve and carry it down.

SOME TROUBLES.

FIRE—A pineapple farm should have each plat, of not more than an acre, with a clear cultivated strip, four feet wide, around it, as a fire-guard, for if fire is started in the patch, of a dry time, it is impossible to put it out.

LONG LEAF.—This is a stunted plant, with long, narrow leaves; when discovered should be taken out, as they will never fruit. Replace with new plants.

SAND.—The sand will sometimes accumulate in the bud of small plants, and in hot, dry weather retard their growth. It is sometimes taken out by a blast of air from a force-pump, but the best way is to pour a jet of water into the bud from an elevation of four feet, and while the plant is wet put a teaspoonful of cottonseed meal into the bud; this forms a barrier, so the sand that again gets in does not burn the plant. The fertilizing part of the cottonseed meal is utilized by the plant, and the crude portion is hardened and pushed out by the growth of the plant, with the sand adhering to it. The cottonseed meal must be put in as often as needed, generally about three times before the plant is out of the way of the sand.

RED SPIDER.—This is a microscopical insect, that feeds upon the tender part of the leaves near the stalk, causing more or less injury. For their destruction, I use the remedy recommended by Captain Thomas E. Richards, of Eden, Fla. Take sulphur, 18 pounds; lime, 20 pounds; boil in 20 gallons of water, forming more than 20 gallons of red solution. One gallon put into a barrel of water makes a solution, of which a gill is poured into the bud of each plant. This is fertilizer as well as insecticide. Repeat as often as necessary.

EXPERIMENTS.

1. In January, 1891, one-twentieth of an acre was set out with suckers and slips of Red Spanish, Sugar Loaf and Prickly Cayenne, two by four feet apart. Sea-grass had been

plowed under, and cow manure hoed in, a month before planting. The plants grew well and now produce fine, large fruit, but the fruit falls over badly and sunburns.

2. In February, 1892, one-twentieth of an acre was planted to Red Spanish, Sugar Loaf and Prickly Cayenne, set two by four feet, in furrows twelve to fourteen inches deep; fertilized with cottonseed meal, one and one-half tons per acre, and kainit, 500 pounds per acre. In June, 1893, this plat produced a little fruit. As a whole, this is a failure.

3. May 9 and 10, 1892, one-twentieth of an acre was planted with suckers of Red Spanish, Sugar Loaf and Prickly Cayenne, set three feet by three feet, and fertilized with dark cottonseed meal at the rate of one and one-half tons per acre. In 1893, this plat produced rather small fruit, but in 1894, the fruit was large and fine. A successful plat, but not planted close enough, as the pines fall over.

4. June 1 to 5, 1892, one-twentieth of an acre was planted with Red Spanish suckers, set eighteen inches by eighteen inches; fertilized with compost at the rate of two tons per acre, and top-dressed with hen-manure. In June, 1893, 250 pineapples were gathered, worth five cents apiece. In June, 1894, 586 pines were picked. Of these, 500 were worth ten cents a piece in the Fort Myers market, and 86 were culls. The plants are very fine. The growth has been excellent. Forty of these pines filled a barrel. This plat a complete success. The compost used was mixed after the following formula:

Dark Cottonseed Meal	1,000	lbs.
Kainit	500	"
Acid Phosphate	500	"
Blood and Bone	500	"
Cow Manure	2,000	"

5. Planted one-twentieth of an acre with Red Spanish suckers, September 6, 1892; fertilized with lime, 20 barrels per acre, and muck, 400 cart-loads per acre, and mulched with salt marsh grass. Planted eighteen by eighteen inches. Plants tender and green, grew rapidly, and I expected them to fruit in 1893. The cold weather of January, 1893, killed most of the foliage, though pines on unmulched beds five feet away were not injured. They did not fruit till late in 1894, and then did not give satisfaction.

6. Red Spanish slips planted October 13 and 14, 1892, on one-twentieth of an acre, fertilized heavily with compost mentioned above, five tons per acre, and mulched with salt marsh grass; set out eighteen by eighteen inches. Injured by cold weather in January, 1893, as was plat, No. 5. Should have fruited in 1894, but failed owing to mulching and probably also compost, in which there was likely too much fermentation after the plants were set out.

7. One-twentieth of an acre, planted with Spanish slips October 18 and 19, 1892, eighteen by eighteen inches. Fertilized heavily with compost mentioned above, six tons per acre, one day before planting out. Should have fruited in 1894. Over half of the plat became Long Leaf, which was probably caused by fermentation of the compost. This compost was taken from the bottom of the pit, and had not passed through fermentation as much as the compost used in plats No. 4 and 6. If the compost had remained in the ground a month before the plants were set, the plat, doubtless, would have been very fine. The remarkable success of plat No. 3 was because the compost was from the top of the pit and well fermented, yet the topdressing of poultry manure was worth still more than the compost. I do not approve of the above formula as a compost for pineapples. It was not of my choosing. I would much prefer cow-penned land, with the addition of two tons of cottonseed meal per acre, worked in two months before planting. What would be still better is blood and bone, two tons, and hen manure, two tons, or guano. I would use sulphate of potash quite freely, after the plants are one year old.

8. Planted out March 22, 1892. In 1894, about one-fourth of the plants produced small apples, worth five cents apiece. Sugar Loaf and Red Spanish slips were planted. This plat was on natural land, without fertilization.

VARIETIES.

The varieties that I have tested are the Smooth and Prickly Cayenne, the Jamaica Queen and Red or Scarlet Spanish, often known as the Strawberry. The Sugar Loaf is as good as any for table use, but too tender for commercial purposes. These varieties are all tender, juicy, aromatic and sweet, with sufficient sub-acid. The Red Spanish, grown in this soil and climate, is scarcely inferior to any other variety. Dr. Hanson has shipped them from Fort Myers to London, England, and they went through in a fair condition.

CONCLUSIONS.

1. My experience convinces me that large crops of excellent pines can be grown in this section, if good cultivation and abundant fertilization are given. I know that pines have been successfully grown some distance north of here. It is altogether probable that pines can be grown with much success in all places in Florida in this latitude, and the great area south of here, containing silica in the soil.

2. Pine land, saw-palmetto land and hammock land, are all good soil for pines, if the fertilizers are suitably applied. A large part of the land in Lee, Dade and Monroe counties, including the Keys on the Gulf and Atlantic coasts, will grow pines successfully. In many sections of these counties, good land for pines can now be bought for $5.00 an acre, though in more accessible locations the price is higher.

3. Pines need generous fertilization. The fertilizers applied should include the three principal plant foods, nitrogen, potash and phosphoric acid. These foods can be secured from stable manure, poultry manure and well-rotted muck, and commercial fertilizers combined in proper proportions.

4. Pines planted eighteen by eighteen inches grow well, are easily cultivated, and yield large crops. When planted in this way, they help to support and shade each other.

5. Mulched pines, in locations where light frosts occasionally occur, are more liable to injury in winter.

6. Great care is needed in using muck and all composts to have them thoroughly decomposed and fermented. Fermentation of any kind is injurious.

7. Suckers and slips do well if not trimmed in any way. I plant them without pulling off any leaves, and without cutting off the lower end. I plant them with the lower leaves spread out under ground and with the soil tramped firmly on the leaves and around the stalk. Captain Horr, of Key West, owning a large pineapple farm on one of the Ten Thousand Islands, tells me he has abandoned the trimming of the plants, and would not have them trimmed, if done for nothing, as his experience is that they do better without it.

L. C. Washburn, M. D.,
Former Superintendent of Sub-Experiment Station.
Fort Myers, Florida, November, 1894.

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Bulletin No. 28. **December, 1894.**

FLORIDA
AGRICULTURAL EXPERIMENT
STATION.

LIVER FLUKE.

SOUTHERN CATTLE FEVER.

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

JACKSONVILLE, FLA.
VANCE PRINTING COMPANY.
1895.

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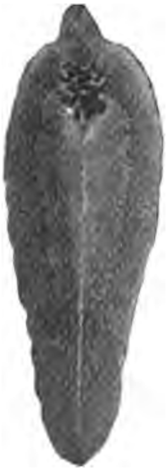


PLATE I.—(DISTOMUM HEPATICUM.)

Plate II, with explanation as below given, is a reproduction from "Animal Parasites of Sheep," by Dr. Cooper Curtice—by the courtesy of U. S. Bureau of Animal Industry.

DISTOMUM HEPATICUM, Linn.

PLATE II.

Fig. 1. Adult fluke, natural size : 1*a*, young fluke, natural size. (Raillet).

Fig. 2. Eggs : *a*, egg with developing embryo ; *b*, egg with embryo ; *c*, egg-shell. (Raillet.)

Fig. 3. Ciliated and free embryo : *a*, perforating apparatus ; *b*, ocular spot. (Leuckart.)

Fig. 4. Encysted embryo found in snails. (A. P. Thomas.)

Fig. 5. Diagram of digestive apparatus and nervous system : *a*, mouth sucker ; *b*, pharnyx ; *c*, œsophagus ; *d*, branches of intestine ; *e*, their branchlets ; *f*, nerve ganglia ; *g*, ventral nerve. (Raillet).

Fig. 6. *Limnæus trunculatus*, the principal snail which is the larval host of the fluke in Europe : *a*, natural size. (Raillet.)

Fig. 7. Redia of *Distomum hepaticum* : *a*, mouth ; *b*, pharnyx ; *c*, digestive tube ; *d*, the so-called germinative cells destined to produce cercariæ. (Leuckart.)

Fig. 8. Redia containing cercariæ : *a*, mouth ; *b*, pharnyx ; *c*, digestive tube ; *d*, *d*, cercariæ. (Leuckart.)

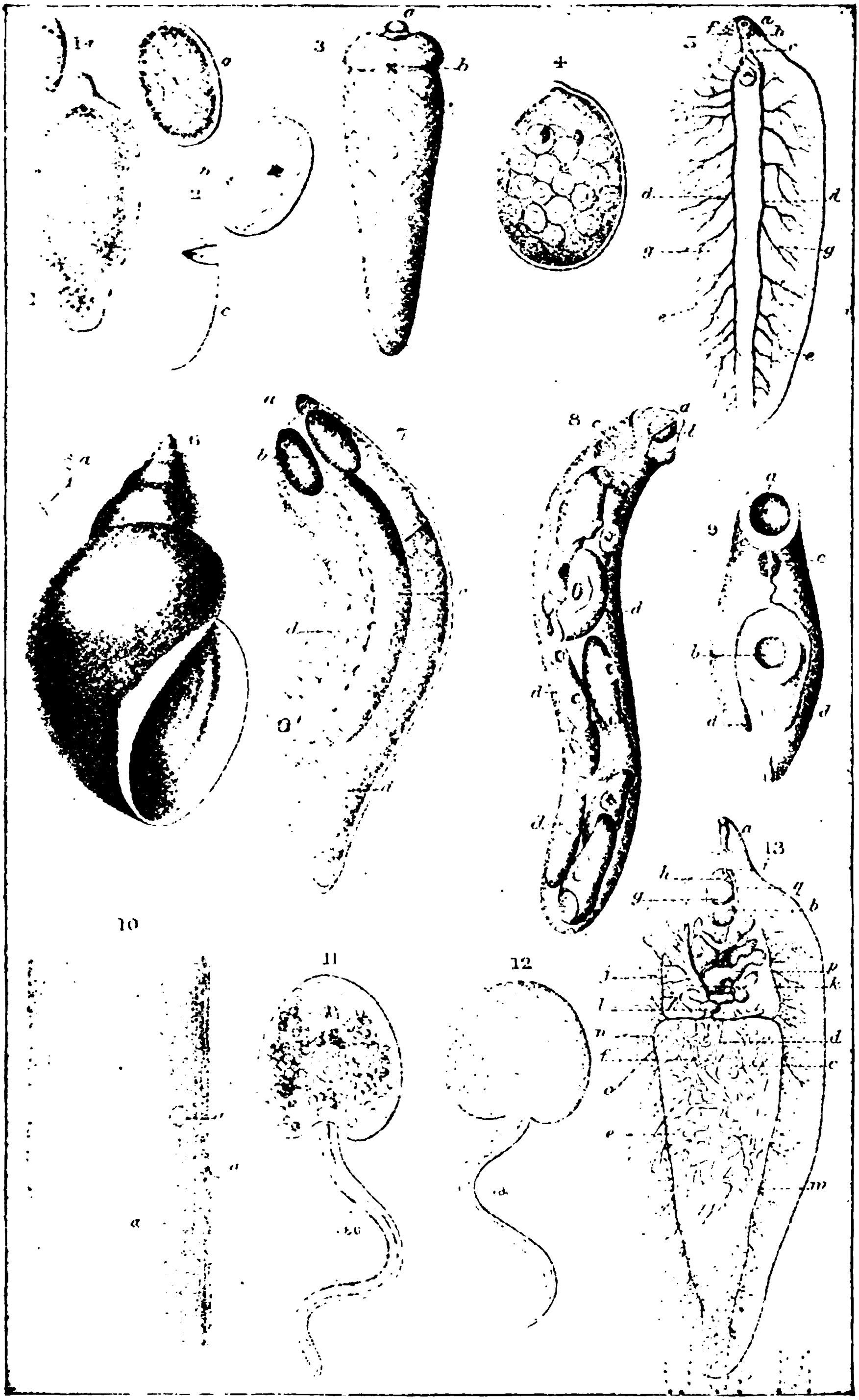
Fig. 9. Cercaria dissected from its cyst : *a*, anterior sucker ; *b*, ventral sucker ; *c*, pharnyx : *d*, *d*, branches of the intestine terminating in cæca. (Leuckart.)

Fig. 10. Grass stalk with three encysted young flukes. *a*, *a*. (A. P. Thomas.)

Fig. 11. Free-swimming cercaria just before it is about to encyst. (A. P. Thomas.)

Fig. 12. A slightly older stage than Fig. 11. (A. P. Thomas.)

Fig. 13. Genital apparatus of the liver fluke : *a*, digestive tube ; *b*, ventral sucker ; *c*, anterior testicle ; *d*, its deferent canal ; *e*, posterior testicle ; *f*, its deferent canal ; *g*, seminal vesicle ; *h*, genital sinus ; *i*, cirrhus pouch ; *j*, ovary ; *k*, oviduct ; *l*, shell-gland ; *m*, yolk-glands ; *n*, longitudinal, and *o*, transverse yolk-gland canals ; *p*, uterus ; *q*, vagina. (Raillet.)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LIVER FLUKE.

LEECHES IN THE LIVER.

Distoma hepatica, L.

BY A. W. BITTING, B. S.

While investigating the external disease of horses and cattle, called "Leeches," I frequently found the term was applied to a disease among cattle of a wholly different character, and due to the presence of a fluke (*Distoma hepatica, L.*) in the liver. Letters were addressed to nearly two hundred butchers and stock men in the State. From the answers and specimens received, the appended map has been prepared to show the permanently infected area. Very few replies were received from the southern part of the State, so that the region lying south of Tampa on the west coast, to Lake Worth on the east coast, remains for future investigation. The permanently infected area embraces a narrow strip from fifteen to thirty miles in width along each coast, and a narrow strip along the rivers to a still greater distance inland from their mouths.

The flukes are sometimes found at other places, but such areas do not seem to be permanently infected. Cattle that graze upon an infected area may be driven inland and carry the flukes for months.

DESCRIPTION OF THE PARASITE.

The parasite resembles the water leech very much in general appearance. (See Plate I.) It is thin, flat, about twice as long as broad, terminating in front with a short protuberance, sides gradually converge from front to the rounding posterior extremity. They measure from three-fourths to one and one-fourth inches in length. They have a palish brown color.

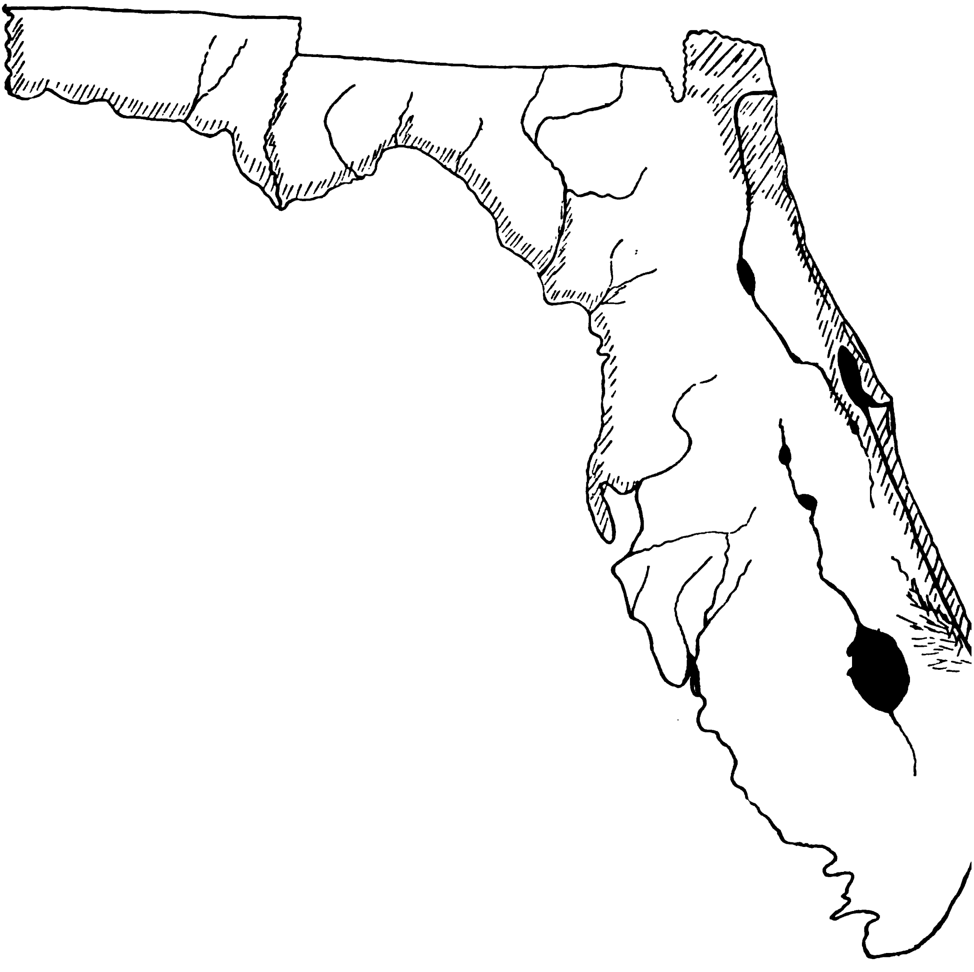
They are found in the bile ducts in the liver, single or in great masses. Owing to their presence the ducts become much enlarged and depositions of dark gritty matter occur. The organ is rendered unfit for food. The life history of the parasite is one of continued metamorphosis. The egg is hatched in water. A snail or other molusk becomes its host for a short time until a change is made. It then leaves its host and becomes encysted on the stems of grass, or floats in the drinking water, when it is taken into the stomach of a cow or steer while grazing or drinking. Once in the stomach it gains entrance to the liver through the bile duct. Here it matures, lays its eggs, and the process is repeated.

EFFECTS UPON THE ANIMAL.

Liver flukes in sheep produce a condition known as rot. As comparatively few sheep are raised in this State, and these are not in the infected districts, no damage is done to that industry. The chief loss comes from growing cattle, and especially from those about two years old. Nearly all cattle in the infected sections have some flukes in their livers. If only a few, little or no effect can be observed; they are found in the best beeves. When they are numerous they may plug the bile ducts, and otherwise so irritate the organ that a general disturbance of physiological functions is the result. Digestion becomes irregular or incomplete, bile is forced into the circulation, the mucous membranes of the mouth and eyes become yellow. The animal is unthrifty, although it may eat heartily. The belly becomes dependent and the brisket and space between the jaws may become filled with a watery fluid. The animal becomes emaciated and either dies or drags along for several months and then makes a recovery.

TREATMENT.

Medical treatment is not a success. The drugs cannot come in direct contact with the parasite, but must first be taken up by the host, so that it reaches the parasite in an exceedingly dilute form, or as a completely changed agent.



Map showing the area permanently infected with *Distoma Hepatica*. Represented by shaded lines.

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More is to be gained by careful selection of the pasture, especially for animals under two years old. Very low pastures are to be avoided, as it is in these that the parasite lives.

SOUTHERN CATTLE FEVER.

Synonyms: *Texas Fever; Spanish Fever; Spleenic Apoplexy.*

BY A. W. BITTING, B. S.

There is much less known of Southern Cattle Fever in this State than in the States north. This is probably true of all the States in the extreme southern tier, yet each year the Secretary of Agriculture defines the line between the region that is infected and that which is free, and no cattle can pass from the south to the north except under specific regulations. The peculiarity of Southern Fever is that southern stock that are apparently healthy are capable of causing this disease in northern cattle, or other cattle that are free from it.

The object of this article is to give only a very brief description of the symptoms of the disease,to call attention to the fact that there are farms that are free from the disease in this State, and to warn those who are desirous of improving the common stock that it is not wisdom to make importations of cattle from north of the Southern Cattle Fever line. For a full dissertation upon the disease the reader is referred to reports by the Bureau of Animal Industry.

Southern Cattle Fever may occur in the acute or chronic form. In the acute form it is of short duration and frequently fatal—particularly so to imported stock. In the chronic form it passes unrecognized, or is treated as some other malady.

If northern or non-infected cattle come in contact with infected cattle the disease will develop in from two weeks to three months. The symptoms come on rather suddenly, the acute form running its whole course in from two days to a little more than a week. The first symptoms are dullness, dropping of the ears, sluggish look from the eye, loss of appetite and sudden diminution of the flow of milk in milch cows. The bowels are more or less constipated, fæces dry and streaked with blood and mucous. Fever rises on the second day and the temperature goes to 103–105° F. The pulse is rapid and breathing hurried. There is a decided weakness of the back, so the animal remains lying down. There is little thirst. The urine is probably lessened in quantity, but gradually increases in color as the disease progresses until it is very red. Death or recovery takes place inside of a week.

A post-mortem shows very little blood in the skin or muscles, and the fat is a brownish yellow. The bile is in very large quantities in the gall bladder, and the intestines and the liver are very yellow. The spleen (milt) is enlarged from three to six times its normal size, and is of very blackish pulpy consistency. The kidneys are congested. The blood is in small quantity and coagulated. Decomposition is rapid.

The acute type of this disease is not of very frequent occurrence among native cattle, but does occur often enough to make it important that it should be better known. A brief history of an outbreak among the cattle belonging to Mr. Cooper, of Tallahassee, will serve as a type. It shows, too, that some farms are free from the disease, and that it is unsafe to move animals from them to infected premises, lest the animals so moved should contract the disease.

Mr. Cooper engaged in the dairy industry northwest of Tallahassee for a number of years. He had good cows, kept them always upon his own premises, and allowed none to enter. He kept them scrupulously clean and free from ticks. At only one time did he buy an animal to take on his farm, and then kept it for a few days until all ticks could be removed before admitting it to the other cattle. This was in June, 1891.

In January, 1893, he came in possession of a farm and herd of Jerseys south of Tallahassee, a distance of a couple of miles from his former place. The land and water were about the same. On the 29th he transferred his cattle (fourteen head) to the newly acquired place among the new cattle. Everything went well until February 10th, when one cow was found to be ill. Her attack was acute but did not develop into a severe form. She recovered in about a week.

On the 11th two more became affected. One died on the fourth day and the other on the fifth day succeeding the attack.

On the 15th another became affected and died on the 16th.

On the 17th five of the younger animals became affected, but all recovered.

During the next two weeks all the cattle that were moved became affected, but none died.

Those that died were soon due to give birth. None of the cattle that were already on the place showed any symptoms of disease.

The animal that was taken to the former place in 1891 became mildly affected. While we had no means of determining to a certainty whether she had come from an infectious farm, the probabilities were almost beyond a doubt that she had. If she did come from an infected place to the former non-infected farm, then she lost immunity against the disease in nineteen months.

All these cattle were examined for ticks, and all found to have them in greater or less numbers. Most of them were very young, showing that they had been there but a short time. The cattle that had been on the farm continuously were badly infected. As the Bureau of Animal Industry has represented the tick to be an important factor in conveying the disease, this would seem to lend proof to their position.

As an example of the disease occurring in imported stock, a carload of milch cows were brought from the North to Titusville and all died in a few weeks. Many similar ventures have resulted in a similar manner. Many immigrants bring cows with them, and these can attest to the fact that few survive.

There are good breeders of cattle south of the Southern Fever line, and to those who wish to purchase stock to improve the common grade, our advice would be to buy from them. The risks of importation from the North are large. In addition to liability to contracting Southern Cattle Fever the northern cow is not always easy to acclimate.

Bulletin No. 29. August, 1895.

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FLORIDA

AGRICULTURAL EXPERIMENT

STATION.

THE SAN JOSE SCALE

P. H. ROLFS.

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THE SAN JOSE SCALE.

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    A Practical Illustration.
Caution.
Send Specimens.
Recommendations.
Conclusion.

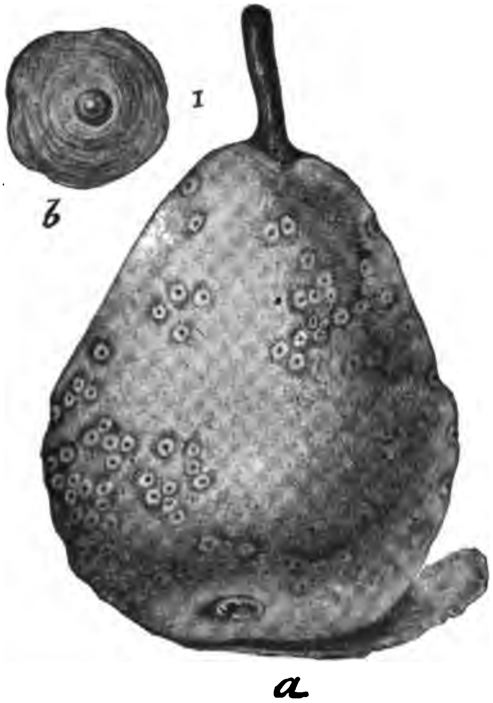

Figure 1—*a*. San Jose Scale on a California pear—natural size.
b. Female Scale as seen from above—enlarged.

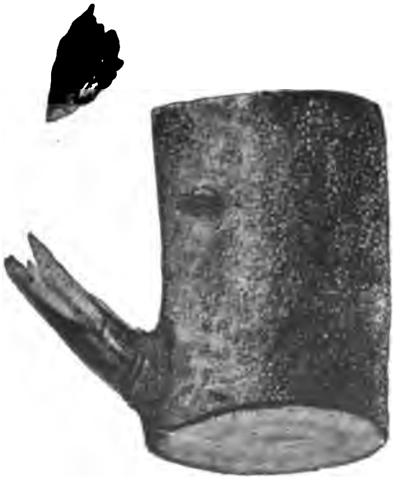

Figure 2—San Jose Scale on apple branch, showing natural size, and number; above and to the left, scales enlarged.

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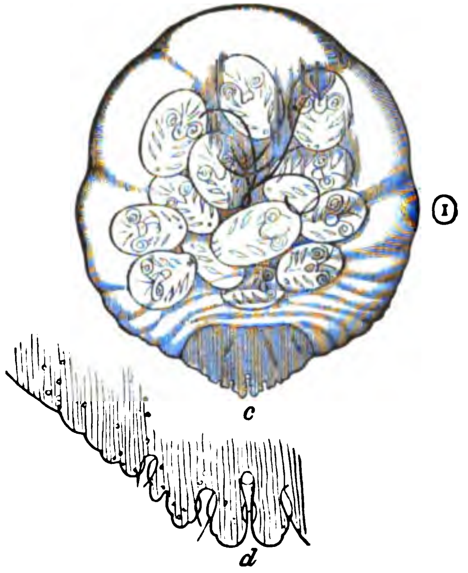

Figure 3—*c*. Adult female containing young—greatly enlarged.
d. Anal fringe of same still more enlarged.

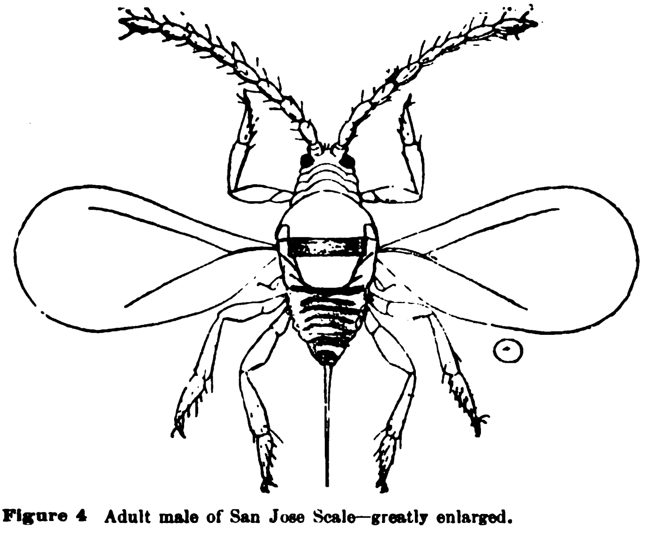

Figure 4 Adult male of San Jose Scale—greatly enlarged.

These illustrations were kindly secured for us by L. O. Howard, Chief of the Division of Entomology, U. S. Dept. of Agriculture.

UCM

SAN JOSE SCALE.

(*Aspidiotus Perniciosus, Com.*)

This insect was brought into California about 1870. It is thought to have been brought from Chili. About 1873 it was known as the San Jose Scale from its inhabiting the San Jose district. In 1880 Prof. J. H. Comstock collected it and named it as above. By 1892 this insect had spread through all the fruit-growing regions of California, and northward into Oregon and Washington. While it was being imported to our State, about that time, no one seemed to be acquainted with the pest.

It resembles the less destructive scales so much that its introduction and spread among the growers of deciduous fruits at DeFuniak was not looked upon with suspicion until it had made serious inroads into orchards, and had killed out at least one. The ordinary long scale of the apple resembles this insect so much, to the untrained eye, that several orchardists insisted that it "never did any harm on our apple trees."

When it was learned through Insect Life that this pest had made its appearance in the East, dilligent attention was paid to all orchards that were reported as not doing well.

SCALE DISCOVERED.

While taking part in a farmers' session of the Chatauqua at DeFuniak, Mr. G. W. Mellish handed me some specimens of infested twigs that were at once suspected as being cases of San Jose Scale. On taking these to the laboratory at Lake City the suspicion was confirmed by a study with the microscope. As a report of the presence of this insect would be very damaging to any fruit-growing section specimens were forwarded to Mr. William H. Ashmead, an entomologist investigator in the United States Department of Agriculture, so as to avoid any possible mistake. Mr. Ashmead pronounced it the San Jose Scale. This was the first intimation that the entomologist of the Department of Agriculture had of the presence of this pest in Florida. On April 7, 1894, they published a notice of the presence of this scale at DeFuniak. I intended to publish a notice of the same nature in the agricultural papers, but as the above-mentioned notice appeared before our notice was mailed it was not sent out.

FIELDS EXAMINED.

As soon as it was definitely known that the pest was in the State, the Experiment Station Entomologist was sent at once to the infested orchards to ascertain to what extent the insect had spread, and also to learn just how badly the orchards were infested.

On examination several orchards were found to be infested to such an extent that it seemed unprofitable to work on them. Out of about 1,200 acres of orchards that lie around DeFuniak, 160 or 200 acres were found to be infested.

SOURCE OF INSECT.

After locating the infested orchards, and noting the severity in each of them, dilligent inquiry was made to ascertain the source of infection. It was at first thought the pest came from a single orchard and that it possibly originated from a single tree, but further study showed that this was not the case, but that some infested nursery had sent a shipment of trees, and the indications are that there have been repeated importations.

The first orchard in which they made their appearance is now practically killed out; there are less than 5 per cent. of the trees remaining, and these are scattered over the whole field. No efforts were made until last year to destroy the insects. It is said to be about six years since the first orchard showed a diseased condition.

It would seem very remarkable indeed if this were the only place in the State infested, because the nursery stock comes largely from the same places. However, only one other location has been found, and this was stamped out immediately by burning the infested trees. As this was on stock only one year from the nursery, the loss was not very heavy. The nursery that sent the stock out was visited immediately, but no trace of scale could be found on the premises. Just how the trees became infested could not be learned.

If there are no other districts in Florida infested by this scale it seems quite probable that no new importations will be made. The fruit growers are quite aware of the danger attending such an introduction, and the nurserymen will do all they can to keep from receiving such notoriety. The greatest danger, then, to our State is that the insect may be present in not a few groves and orchards in small numbers without the owners being aware of it.

INFESTED NURSERIES.

Competent entomologists have reported two nurseries in New Jersey, several on Long Island, N. Y., and one in Missouri. None of the Southern establishments have been discovered as disseminating or containing diseased stock, but that should not allow us to be any the less cautious and suspicious. It does not follow that because the scale has not been discovered in an orchard or nursery that it is not there.

It occurred several times, while I was inspecting orchards at DeFuniak, that only one tree out of a hundred was found to contain any insects at all, but the presence of a single infested tree is as dangerous to an orchard as a single case of cholera is to a community.

We have all reason to believe that the dissemination of diseased trees by nurserymen was entirely free of any bad intention, and due to an ignorance of the presence of the scale. As soon as the presence of this pest was discovered all efforts were made to stamp it out.

OCCURRENCES IN THE EAST.

So far the insect has been found, in the East, in the following States: Missouri, Indiana, Ohio, Maryland, New Jersey, New York, Pennsylvania, Virginia, and Florida. New Jersey and Missouri seem to be largely responsible for its dissemination in the East. They have been traced directly from New Jersey to California. They were brought to New Jersey on some Kelsey plum trees in 1886 or 1887. While the original trees were destroyed it was not done until after the scale had infested considerable other nursery stock.

VARIETIES OF FRUITS INFESTED.

There are a great many varieties of fruits infested, especially those belonging to the Rose family, (order *Rosaceæ*). All varieties of pears, plums and peaches are liable to be attacked, apples, cherries and quince are also attacked, but as these are not grown for profit in this State, they need not be considered further than that they are hosts for these pests. We have reports also of their occurring on English walnuts, European elm, persimmon and rose bushes.

The Japanese plums (not loquats or medlars) are most severely attacked; next to these are peaches. Apple trees are often attacked severely, but these are so few and so scattered in this district that they are not of much economic importance. Of the pears the LeConte and Keiffer varieties are least attacked. These varieties are almost immune, but as they support the insect, an infested LeConte or Keiffer tree must always be considered a source of infection for less hardy varieties. Some Bartletts are so deformed by the pest that they could scarcely be recognized. Professor Smith finds that the LeContes suffer more from the insect than the Keiffers in New Jersey, while observations indicate that the reverse is true here. In an orchard that is made up of plums and LeContes the insects have nearly ruined the plums, while the pears are apparently as vigorous as though no scale were present. There are thirty-seven trees to the row, and the two kinds are planted alongside of one another. The orchard was cultivated regardless of variety. Beyond the fourth row of pears, from the plums it was difficult to find any scale.

Adjoining this orchard there was an orchard of sixty trees obtained from a large Georgia nursery. In 1892 it was noticed that this was diseased, in the fall of '94 three-fourths of the trees were dead, ten trees were still healthy looking, but covered with scale, and the rest were sickly.

REMEDIES.

The remedies used were those suggested by the Div. of Entomology, U. S. D. A.; Kerosene Emulsion and Resin Wash. Below are given formulæ and directions for preparing these insecticides:

KEROSENE EMULSION.

Soap (hard or whale oil)	½ pound
Water	1 gallon
Kerosene	2 gallons

PREPARATION.

Dissolve a half pound of hard soap in a gallon of boiling water. The soap will dissolve more quickly if it is cut into small pieces, and the water, with the soap in it, stirred while heating: The heating may be done in an ordinary iron kettle. When the water is heated to boiling and the soap all dissolved, the kettle may be removed from the fire and the kerosene added, care being taken not to ignite the kerosene. After the kerosene has been added the mixture should be thoroughly churned for ten minutes. A good way is to force it through a spray pump back into the kettle several times. Emulsion prepared over a fire with the water near boiling kept two years without separating entirely.

In making kerosene emulsion there are two points to be kept in mind constantly. 1st. To keep the water and kerosene just as hot as possible without igniting the kerosene. 2d. That during this time the material must be thoroughly and vigorously agitated. Merely stirring with a paddle will *not* do. Nor will it make emulsion by using warm water. The nearer the igniting point of the kerosene and the harder the material is churned, the better will be the emulsion.

The emulsion may be tested by placing a corked bottle full of it in a cool place for twenty-four hours; if no clear liquid rises to the top nor dark liquid settles to the bottom, the emulsion may be considered good.

Some trouble has been reported from the use of hard water; it is therefore recommended that rain water be used in those districts that have hard water.

When ready to use take one part of the preparation and nine of water; stir it until it is mixed evenly, and apply.

This insecticide is recommended for insects that obtain their food by piercing plants and sucking the sap, as plant lice. It is also an excellent remedy for the young scale before the wax has been secreted. This has also proven an excellent wash to kill lice and other parasites on animals. Care must be taken, however, that no free kerosene remains, as this will rise on the mixture and coming in contact with some tender-skinned animals might cause the hair to fall. When diluted with twelve parts of water it has given excellent results in killing lice on cattle. It is applied to the animal with a spray or force pump.

RESIN WASH

is one recommended by the Division of Entomology, United States Department of Agriculture, as a summer wash for the San Jose scale.

Resin	20 pounds
Caustic Soda (70 per cent strength)	5 pounds
Fish Oil	3 pints
Water to make	100 gallons

PREPARATION.

Place the resin, soda and fish oil in a large kettle, put in enough water to cover four or five inches deep; then boil for an hour or an hour and a half, when the liquid will be a dark, coffee-brown color. Water is added gradually and the liquid stirred to keep it mixed evenly.

RESIN WASH FOR WINTER.

Resin	30 pounds
Caustic Soda (70 per cent strength)	9 pounds
Fish Oil	4½ pints

THE TWO REMEDIES COMPARED.

Both the Kerosene Emulsion and Resin Wash were used in orchards at DeFuniak with good effects.

Resin Wash—At first the formula for summer Resin Wash was used, but the strength was gradually increased to that of the Winter Resin Wash. This killed all the young scale and nearly all of the older ones, but a few of the places on the trees were not touched and consequently it failed to kill all insects. During the fall the insects secrete themselves between the bud and the portion that holds the leaf. These places form small pockets, or recesses, that the insecticide does not enter, hence does not cover them. Insects hidden in such places escape to start new broods.

SPRAY THOROUGHLY.

In using either of the above insecticides it must be remembered that only such insects are killed as are covered with the material, hence, any portion of the tree left unsprayed may carry the disease over. This was very noticeable this year; wherever last year's work had been done thoroughly there were few insects to be found.

Some trees were tried as special tests, and completely covered with the wash, with a view of noticing the effect on the tree; no live scale could be discovered by a most dilligent search and the trees were not killed.

An orchard that was considered worthless last year, when treated to a thorough spraying of Winter Resin Wash was almost entirely free this year. However, it did nearly as effective work on the flower buds for this spring, nearly all of which were killed.

DON'T USE THE WINTER WASH IN WINTER.

The term "Winter Resin Wash" was given to this formula because the trees in the Northern climates pass through a long dormant state in winter, and are not easily hurt in this condition. In such climates it was found that the trees could stand a much stronger insecticide during the winter. In our State the fall merges into spring, and the trees do not take on the dormant winter state. Very often the early peaches begin to bloom in December, and continue to send forth a few blossoms during warm spells until the spring bloom has disappeared.

A very interesting fact was developed during the work. Where the Winter Resin Wash was used later than the first week of November it killed a great many flower buds. The damage increased with the thoroughness of the spraying, and with the advance towards spring. In some orchards where the application was thorough and late (about February) practically all the fruit buds were killed, but no other damage was perceptible.

A very good illustration of the critical strength of the Resin Wash occurred in a seven-acre orchard. In the forenoon the usual winter wash was used, at noon the strength was increased. The portion of the orchard treated in the afternoon bore practically no fruit, and the scale was also much less severe. The orchard was sprayed about November 1.

KEROSENE EMULSION.

This substance was used about double strength on several orchards, including the one on the DeFuniak branch Experiment Station. Superintendent Stubbs had this orchard treated about the last of October. The insects were not severe on the premises. This year there seemed to be even more than there were last year.

As this seems to be the usual verdict on the use of Kerosene Emulsion we would not recommend it as the most effective remedy. It has the advantage over Resin Wash that it is not liable to injure the trees or fruit, and that it can be used at any time during the summer. It would probably have little value as a winter wash.

If used it will be necessary to repeat the spraying at shorter intervals than in the case of the Resin Wash.

COMPARISON OF KEROSENE EMULSION AND RESIN WASH.

Cost of material for making 100 gallons Kerosene Emulsion:

5 Pounds Hard Soap, at 3c.	$ .15
20 Gallons Kerosene, at 18c.	3.60
	$3.75

Cost of material for making 100 gallons Resin Wash:

20 Pounds Resin, $1.80 per barrel	.18
5 Pound Caustic Soda, .6½	.32½
3 Pints Fish Oil, .60 per gallon	.22½
	.73

The formula for summer wash is used, because it is as effective as the Kerosene Emulsion. The labor of preparing is about the same for each. The Winter Resin Wash, on the same basis, will cost $1.19½ per hundred gallons.

SPRAY DURING DRY SEASON.

Several orchards were sprayed just before heavy rains. The result of the work in such cases was far from as satisfactory as in the cases where the spraying was followed by dry weather. The reason for the less effectiveness in the rainy season is that the insecticide, which forms a coating over the insect to smother it, is washed off before the insect is killed.

PERSISTENCY OF THE PEST.

It is certainly very difficult to eradicate the pest when it has once established itself. While the spraying solution may kill all it comes in contact with, it will be found exceedingly difficult to reach every insect on the tree. There will be very little trouble, however, to keep the pest down, and to prevent its spreading to young orchards, if one uses the spraying solutions at the proper times and uses them thoroughly.

There are other insecticides and other methods that might be used in combatting this insect, but as these could not at the time be tested we cannot report on them.

The use of cyanide gas and tents is commended where one has a small orchard. This method is said to kill out the last remnant of the scale, but it is expensive and tedious.

NATURAL ENEMIES.

The officers of the Division of Entomology, in the Department of Agriculture, have discovered several insect enemies of this serious pest, but as these parasites do so little effective damage to the progress of their host, it is not wise to depend on them.

During the spring Mr. G. H. Hallowell, President West Florida Highland Fruit Growers' Association, found an interesting and seemingly an effective enemy of this scale. The find was reported to the DeFuniak *Breeze.* Mr. Hallowell kindly sent us some specimens of these parasites. Upon rearing them to maturity, they proved to be our omnipresent friend, the twice stabbed lady-bird (*Chilocorus Birulncrus*). On July 26, the orchard was visited and it was very evident that "No trust can be safely placed in these natural enemies. A little active work will benefit the farmer more than all the natural enemies can possibly advantage him in ten years to come."

The following discussion of the Life History, and How the Insect Spreads, has been taken from Bulletin 106 of New Jersey Experiment Station, by Dr. J. B. Smith.

LIFE HISTORY.

"As the study of this insect is a matter of national importance, it has been taken in hand by the Division of Entomology of the United States Department of Agriculture. Indeed, the insect had been studied and its life history ascertained in California years ago, so we are quite familiar with its general habits and development. I deemed it unnecessary to duplicate work and made no attempt at original study. I have confined myself to observing the development and habits of the insect in our State, and to ascertaining those points that are practically important in its treatment. The life history that follows is therefore taken, in its essential features, from Circular No. 3, Second Series, of the United States Department of Agriculture, Division of Entomology, supplemented by my New Jersey observations. The illustrations are also from the above mentioned circular, electrotypes being procured by the courtesy of the officers of the Department.

"The San Jose scale belongs to the group of armored insects, to which the common oyster-shell bark-louse of the apple belongs. It differs from that species in that the scale is perfectly round, or at most very slightly elongated and irregular. In these particulars it resembles the 'scurvy scale,' *Chinnaspis furfurus*, or 'Harris louse,' as it seems to be quite universally called in this State; but it is decidedly smaller and more convex than the latter species. Its round shape and small size distinguish it at a glance from all the other species infesting deciduous fruit trees in our State. It is quite flat, a little raised in the center, pressed close to the tree around the edges, resembles the bars of the twigs in color, and when full grown is decidedly less than one-eighth of an inch in diameter, perhaps the majority of the scales do not equal one-sixteenth of an inch, where they are closely crowded together; but where a few only are found on the succulent shoots, or on fruit, they become larger, and the females may, in extreme cases, reach nearly one-eighth of an inch. The males rarely exceed one-sixteenth inch in diameter. At or near the middle of each scale is a small, round, slightly elongated black point; or this point may sometimes appear yellowish.

"When occuring upon the bark of twigs or leaves in large numbers the scales lie close to each other, frequently overlapping, and they are at such times difficult to distinquish without a magnifying glass. The general appearance which they present is a grayish, very slightly roughened, scurfy deposit. This is much more prominent on the trees like the peach, or those varieties of apple and pear that have a reddish color, and when these are thickly infested they seem to be coated with dust or ashes. When the scales are crushed by scraping, a yellowish, oily liquid will appear, coming from the soft yellow insects beneath the scales, and this will at once indicate to one who is not familiar with their appearance the existence of healthy, living insects beneath the scaly covering.

"These are easely scraped off with the finger nail, and the bark beneath them will be seen to be darker in color, as will be seen by comparing the places from which the scales have been removed with the spots upon which the scales do not occur, while the circumference beyond the scales frequently becomes changed in color to a somewhat purplish or crimson shade. Where the scales do not occur so thickly they are more perceptible, and upon young, reddish twigs the contrast is quite noticeable, as the scales there appear light gray. Younger and smaller scales are darker in color than the older and larger ones, and sometimes appear quite black, while, on the other hand, those that are just set may be white or yellowish.

"During the winter the insect is to be found in the half-grown or nearly full-grown condition, and as soon as the trees resume activity in spring the insects resume their feeding. In New Jersey they reach their full growth during the latter part of May, and the young begin to hatch and crawl from under the female scales during the first week in June, and from this time through the summer there is a constant succession of generations. The first living larvæ that I received reached me on June 11th, having been gathered June 10th, and at that time I found on the twigs a number of young scales that had just set, indicating that active larvæ had been about at least three or four days previously. Up to June 15th every infested tree examined showed active young larvæ, and after that time there seemed to be a period of about a week or ten days during which no larvæ were noticed. Early in July, however, young larvæ were again active and crawling about everywhere, and this condition of affairs continued throughout the balance of the summer extending through October, and even into the first part of November until, in other words, the trees had become quite dormant. The young louse is an active, crawling creature, very minute and yellowish in color. The young spread out upon the new growth of the tree, settle down, and each begins to secrete a scale. The male is an active two-winged insect, while the full-grown female loses her legs and antennæ, and bears a very slight resemblance to a living creature.

"The insect affects not only the young twigs and limbs, but covers as well the trunk to the surface of the ground, and exists upon the leaves and upon the fruit. When it is abundant the fruit is destroyed, or at least rendered unfit for market. One of the most characteristic points in the appearance of the insect upon fruit is the purple discoloration around the edge of each scale.

So far as we know, this result is confined to this species alone. Upon the leaves the insects have a tendency to collect along the midrib on the upper side of the leaf in one or more quite regular rows, and also to some extent along the side ribs. The infested leaves turn brown, but do not have a tendency to fall as a result of the damage.

"There are two points of interest and importance to be noted in this life history. The first is, that the insect passes the winter beneath the scales in a partly grown condition. Usually they are about half grown, but some will be younger, and some will be older. They seem to continue reproduction until the tree is entirely dormant and no further food is obtainable. On the other hand, they do not seem to renew growth very early in the spring, but are slow to begin reproduction; no larvæ having been noted until June, as has been already stated. The second point is, that once they begin there is practically no period during the summer at which the young, active, crawling lice are not to be found upon the tree. The length of time during which a given female will continue to reproduce has not been ascertained, but it seems likely from what has been observed that breeding continues for quite a long time, and that the female scales that have lived during the winter may continue to live on and reproduce during the greatest portion of the summer, when their daughters and grand-daughters are already full grown, with nearly full-grown progeny. There may be, therefore, upon a plant at one time, young born of as many as three, or even four distinct generations. As nearly as I have been able to ascertain, from my observations during the present season, a little less than a month is required to bring an insect to maturity. That is a larva hatched today will be ready one month hence to bring forth living young in turn, and this will allow at least four, if not five, distinct broods during the summer and fall."

HOW THE INSECT SPREADS.

"It has been stated that the full-grown male of this insect is winged. It is very minute, scarcely noticeable without a lens, very light and frail, at the mercy of the least puff of wind, and incapable of any great journey. The female has no perceptible legs, and is utterly incapable of motion. She resembles a yellowish, or orange, flattened seed, in bulk many times that of the male, but firmly fixed to one point by the scaly covering, which is at once her protection and her grave. The young are active for a very brief time, two or three days at most, and they crawl with considerable rapidity and great persistence, so that they might possibly descend from one tree and crawl for a number of yards to another; but the spread in this manner is insignificant. Where trees are close together they may pass from the branch of one tree to another; but I have found that they rarely crawl long in any one direction; they rather move around, rapidly enough, yet irregularly and at random. Usually they do not go farther than is necessary to find a good place to fix, and at once begin to form a scale. This process is rather interesting and can be watched. As soon as the young louse has inserted its beak into the plant, and has begun to feed, a change comes over it, and within a few hours it is entirely covered with a fine, white, waxy film. This turns first yellow, and then gray, or even black, and the creature is a fixture, absolutely incapable thereafter of shifting its location under any possible circumstances. Strong winds may carry the young bodily from one tree to another; but the principal method of spread is by means of other insects which are winged, and by birds. The active young lice will soon crawl upon any small winged insect, particularly if the latter is of a dark color, and they may be carried by it to considerable distances. They also crawl upon the feet of birds which visit the trees, and may thus be carried for miles. They are often found upon ants, and ants, as everyone knows, are great travelers. This difficulty in moving from one place to another, and the dependence upon external agency for their distribution, will account for the fact that trees here and there in an orchard newly set out may be very badly infested, while not a trace will be seen on the trees on either side. Few birds or insects visit a young orchard that is at all well kept, and the distance between the trees, especially if the land is cultivated, is altogether too great to be covered by the young lice, even did they know enough to make a bee-line for the nearest point. The result is that nearly every young scale fixes upon the tree on which it was hatched, killing it more rapidly than would otherwise be the case; but at all events confining and preventing spread to points not theretofore infested. This also explains why nursery stock is so evenly troubled: here the trees are grown just as closely together as is possible in rows, and there is no hindrance to crawling from one to the other.

"As the insects must feed for a time in spring before attaining their full growth, it follows that only such as are fixed to the tree itself have any chance of reproducing their kind. Those that fix to the leaves fall with them, and as they dry or decay the insect dies for want of food before attaining maturity."

A PRACTICAL ILLUSTRATION

of how the insect spreads was afforded in Florida. Growing in an infested orchard were some melons which were kindly offered to a friend about three miles away, who took some from the orchard in a wagon to his home. A year later scale developed on the place that was free before. The first appearance was on a tree under which the team had been hitched while the melons were taken to the kitchen.

The case is clear enough; the team and wagon driven into the infested orchard became the means of carrying the insect through a distance of three miles. No doubt these were the young crawling scale that had restlessly wandered onto the harness or wagon, and then crawled off again when the opportunity afforded escape.

CAUTION.

It is strongly urged upon all dealers of fruit trees in this State, and in other States as well, to be exceedingly careful in disseminating fruit trees grown by some one else. After this all stock will be regarded as suspicious by our fruit growers. It is exceedingly damaging to have the unenviable reputation of sending out diseased stock. The Experiment Station reports on specimens sent for examination. It is not known for what purpose the information is desired, and, in the majority of cases, the enquirer is not known.

One case came under my observation where the nurseryman seems entirely innocent of intention at fraud, and ignorant of the fact; possibly he handled a few trees from another nursery.

SEND IN SPECIMENS.

All persons are urged to send specimens of suspicious looking twigs to the experiment station for examination. In the beginning the insect can be stamped out with comparatively small loss.

RECOMMENDATIONS.

1. If the San Jose scale is on a lot of trees just received from a nursery, *burn them* immediately, wrapping, box and all.

2. If the trees have been set out you will do wisely if you destroy them, and do not plant the place to trees subject to this disease for a year.

3. If there is only "here and there" a bearing tree

badly affected, it will be cheaper to grub it out and burn it on the spot.

4. If the orchard is generally affected, spray with resin wash or kerosene emulsion during the dry season. Repeat the spraying about every ten days or two weeks.

5. Do not use the winter wash later than the first of November in this latitude; it is liable to kill the flower buds.

6. We recommend that all stock received in quantity be thoroughly fumigated in the original package. For this purpose use potassium cyanide, 1 oz., sulphuric acid, 1 oz., water, 2 oz., for a box 4x4x6 feet; for other sizes use same proportions. Put the water in a saucer or similar dish, add the acid, then the cyanide. Close package up quickly and *be sure not to breathe any of the fumes;* it is a *deadly poison.* Keep the package closed for twenty-four hours.

7. If a young orchard is to be planted in an infested district, be sure to have a strip of woodland left between the new and the old orchards. Be careful also not to carry implements from the old orchard to the young. By exercising dilligent care the insect may be confined to the old orchard.

CONCLUSION.

The San Jose scale is an exceedingly *pernicious* insect; it can be controlled by spraying with resin wash or kerosene emulsion. The remedy is practicable and profitable; this was demonstrated in an orchard of twenty acres. The insect, when thoroughly established, can be be exterminated by the use of these sprays only with great difficulty if at all.

The spraying should be repeated; one spraying is good, but two are better.

Bulletin No. 30. November, 1895.

FLORIDA

AGRICULTURAL EXPERIMENT

STATION.

The Culture of Tobacco

F. B. MOODIE.

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

JACKSONVILLE, FLA.
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1895.

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THE CULTURE OF TOBACCO.

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THE CULTURE OF TOBACCO.

INTRODUCTION.

This important industry in Florida has been greatly embarassed for several years past by a combination of unfortunate circumstances, the most serious of which have been overcome; the only one remaining being a lack of desirable information as to the proper cultivation, fertilization and manipulation of the plant. This the Experimental Station hopes by this, and other bulletins, to impart.

The agitation of the tariff on imported cigar leaf necessarily unsettled values, but the last congress fixed the duty in the growers' favor at $1.50 per pound on wrapper, and 35c. ou filler.

The last, but not the least, difficulty has been the paucity of the crop, making it so easy for dealers to dictate and control prices,while they would skillfully manipulate and disguise our product, and put it on the market either as "Genuine Havana," or "*Havana F.*" This difficulty will now, no doubt, be removed by the revolution in Cuba creating a demand for the Florida product many times greater than the possible supply. Devastating armies, reinforced by cyclones and floods, have destroyed the tobacco plantations of the Vuelta Abajo and other districts in Cuba, and the probability is that the home demand will exceed the '96 crop, and possibly that of several succeeding years.

Thus it appears that Cuba's extremity will be Florida's opportunity, for no other State in the Union has the soil and climatic conditions necessary to provide a substitute for Havana tobacco. Indeed, Florida is now looked to and called upon by hundreds of large factories in this country to supply this much-needed commodity, and it is possible that there may be an export demand, as other foreign countries can no more get Havana leaf than this country can.

As soon as the financial condition of the Experiment Station will permit I shall conduct some careful experiments in the cultivation and manipulation of several of the most popular types of cigar filler and wrapper tobaccos, and also of the most popular types of bright plug wrapper—the cash demand for which is always greater than the supply of the fine quality to which our soil and climate are preeminently adapted. The experiments will be in charge of an experienced tobacco grower. The frequent letters asking for information as to tobacco culture indicate a present wide demand for the latest knowledge on this subject. To meet this demand by the preparation of a bulletin I secured the services of Prof. F. B. Moodie, who has had over twenty years experience in Virginia, North Carolina and Kentucky plug tobaccos, and has devoted the last ten years steadily to experimentation in growing and manipulating the best types of cigar leaf in Florida, and whose writings on this subject are now very widely quoted and regarded as authority; so that the public will feel confident that his instructions and directions will be a safe guide for beginners, and even profitable to those with some knowledge and experience, particularly those whose experience has been limited to other States, which would most likely mislead them in Florida, which has soil and climate peculiar to itself.

O. Clute,
Director.

Lake City, Fla., Nov. 25, 1895.

THE CULTURE OF TOBACCO.

I shall direct attention first, to the culture and treatment of cigar leaf, and then to the culture and treatment of the bright plug leaf, that being the only type of plug tobacco that it is advisable to plant in Florida.

SELECTION OF SEED.

I have experimented with over twenty varieties of cigar leaf but have rejected all but three or four, they proving the most profitable. If the object is to supply a substitute for Havana wrapper and filler, the consensus of opinion is in favor of the *Vuelta Abajo.*

If the object is to grow a crop of wrapper tobacco, the poorer leaves of which make only an inferior grade of "binder" or "filler," genuine Sumatra seed is to be recommended, provided the soil is fresh, gray, sandy-loam hammock, or even "black Jack ridges" if properly enriched. But I am not as yet convinced that old lands, which have lost their original virgin properties, are to be recommended for this variety of wrapper tobacco, for in the Island of Sumatra, *only* the virgin soil is planted. There is no doubt that there are some Florida lands that will produce by skillful management, a wrapper from the genuine Sumatra seed, that will rival, and in point of quality, even surpass the Sumatra leaf, for the imported article is devoid of aroma, and is only a bitter but beautiful *cover* for a cigar.

After ten years searching, I have at last just found the old celebrated *ante bellum*, Florida Speckled Wrapper, that was so eagerly sought for by the Amsterdam and Hamburg leaf dealers. After the late war between the States broke out, and the ports were blockaded, they sought for another Florida soil and climate, and in the Islands of Borneo and Sumatra and in the Kamaroon experiments were made to obtain a substitute for the old Florida speckled leaf, and now Sumatra wrappers are the most popular and expensive in the world, and will be till this old Florida favorite is brought again into notice, and Rip Van Winkle-like, is re-introduced to home and foreign markets. But it must be borne in mind that in the harvesting of either one of these types it is better to "prime" off the leaves into large, flat baskets, and string them on wire, cord or slender sticks. I prefer common baling wire cut into pieces about fifteen inches long, on which the leaves are strung face to face or back to back; (not spooned, as that would blacken them). Sit down by a basket of leaves, take the wire on the knee, forcing the end through the large end of the stem, first on one and then the other side, and when full hang astride the lath and put up on poles to dry.

The so-called Ma Nicaragua, or Moodie's Hybrid, which won both Medals at the Centennial in Cincinnati in '88, and twice at the other fairs, and was pronounced by a committee of New England Experts, as the "finest wrapper ever grown in the world," succeeds only in certain light Hammock lands, when planted very early. It makes on old land a good filler. I lost my stock of seed when my residence burned in spring of '94, but hope to restock from an ounce restored by a friend.

HOW TO DISTINGUISH PERFECT FROM IMPERFECT SEED.

Put a few seed on a clean, hot tin or stove, when if the seed are dead they will quietly burn black; otherwise they will remonstrate, by an apparent endeavor to jump off. If, however, only a few complain of the intense heat, double the quantity to be sown on the bed. But better get fresh seed.

TIME TO SOW SEED.

In the northern counties of Florida sow the first beds from the 1st to the 10th of January; then sow one or more beds every week or two till the last of February, to insure a sufficiency for a large crop. It is not safe to rely on one seed-bed. Further South seed may be sown earlier, the object being to transplant just as soon as danger of late spring frosts is past, for tobacco, like tomatoes or other vegetables, should be in the field as soon as safe from frost.

LOCATION AND PREPARATION OF SEED-BEDS.

Select a rich, moist place, near as possible to water, and if sloping to the south the better; not one much shaded —must have sunlight. On the nature of the seed-bed soil depends the nature and worth of the plant. It must be borne in mind that *foliage* and not fruit is the objective crop. If seed are sown on very light sandy loam, dry and thirsty, the roots will descend deep into the ground for moisture, and there will be no surface lateral rootlets, but only a long "tap-root" with a very few branches. On such a plant the leaves will be short and very far apart like a mullein stalk. Whereas, the seed sown on moist and closely compacted land will produce stocky seedlings with abundant surface rootlets, which will develop an umbrageous, spreading plant, with abundant and more valuable foliage. I must admit that I have learned this important fact after forty years' observation.

Virgin soil is better for the seed-bed than old land, unless the old land has been well mulched the previous summer, thereby destroying much of the seed of grass and weeds, which is the chief object of burning the ground. Thorough mulching also restores measurably the virgin properties to old soil.

It is important to burn the seed-bed well, in the following manner: Rake off leaves and trash, lay green poles four to six feet apart, pile on brush uniformly for kindling if you have it convenient. Then throw on heavy sticks of wood at right angles, with old rails or dry wood between, across the poles or skids, which serve to elevate the burning wood, admitting of oxygen to support free combustion immediately over and near the surface. After the smaller wood has been burned, with a long-handled hoe or hook, draw the remaining large pieces to the margin, and so extend the area of the bed. When it has cooled, dig up closely, leaving the ashes on the ground, being careful not to turn the burnt surface upside down. Do not plow. Then, with prong hoe and rake, remove all roots and small stumps and level the surface nicely, raising it about six inches on the margin by a small ditch to carry off surplus rain.

QUANTITY OF SEED AND HOW TO SOW.

One heaped tablespoonful of good fresh seed to fifty square yards, mixed thoroughly into a half gallon of corn meal or white ashes, so as to *see* when the ground is well seeded. Better to mark off spaces with a stick about four feet wide. Sow with thumb and two fingers, when no wind is blowing, and leave a little to sow across the other way to insure uniform stand. Don't rake the seed in as some will be too deep, but rather use a long, stiff switch and sweep lightly, and then with a pair of quickly extemporized snow-shoes (made by nailing a strap for the foot on a piece of board 10 by 12 inches), tramp the bed over evenly. Leave the margin slightly raised to run off surplus water.

For protection from frosts, cold winds, flea beatles, etc., it is safer to cover with thin, cheap cotton cloth. This also secures greater uniformity of moisture and temperature. While a covering of straight, leafless brush may suffice, the canvas is far better, for it will insure earlier plants. But the canvas must be removed at least ten days or more before the time of transplanting, otherwise the plants would be too tender. Always aim to have twice as many plants as you need.

THE KIND OF LAND BEST ADAPTED TO CIGAR LEAF.

There is no longer any question that new, gray hammock of sandy-loam is the best; and if bright wrapper is wanted, even this should have a yellow or light-colored subsoil, either clay or sand, the latter being preferable for growing leaf of the finest texture. But any good sandy-loam in Florida, if not too wet, may produce good cigar tobacco, if not impregnated with lime or clay in the surface.

As in the Mineral kingdom, the most precious metal, gold, is never found disassociated from silica, (sand), so in the Vegetable kingdom, the finest qualities of texture aroma, flavor etc., are only to be produced from silicious (sandy) soils, unmixed with the baser calcareous, ferruginous, and argilaceous elements, i. e., lime, iron and clay. However, if a sub-stratum of clay occur one foot or more below the surface, it is no disadvantage, but may be a mechanical benefit, as a base to support moisture, for the "tap roots" of plants and trees serve only as an aqueduct to supply water, while the surface lateral rootlets reach out for sustenance; hence all fertilizers should be lightly covered from the sunlight.

It is also a fact that the finest cigar leaf in the world is grown only on tropical and semi-tropical Islands and Peninsulas—(e. g., Cuba, Sumatra, Florida, etc.)—where much of the make up of the soil is marine drift and the climate is warm and humid, for it is known to experts in cigar leaf that it requires a humid atmosphere from the seed to the cigar, and the reverse is deleterious, and if continuous, is ruinous.

NATURAL INDICATIONS OF CIGAR LEAF LANDS.

The true relation existing between Geology and Botany is less understood than any rudimentary principle of Agriculture and Horticulture. It underlies every other, and if violated, "mother earth" refuses to yield her increase and spurns every pseudo-scientific experiment. Figs will not grow on thorns nor grapes on thistles. We must turn back to nature's elementary spelling book—nor expect to "go on to perfection" until we learn the first principles, *i. e.:* why this, or that, or the other tree or shrub, or plant or grass, grows spontaneously or indigenously out of certain soils as a true habitat, coming up at nature's bidding and growing to perfection, overcoming every other tree, or plant, or grass that man, without proper thought, undertakes to intrude. Thus it must be made plain that in order to obtain the highest results we must not disregard nor disobey the dictates of nature. Fine cigar leaf only is desirable. While a fine or fancy leaf will always command a fancy price, an inferior grade may be worthless. Without proper soil, climatic conditions and environment the best results need not be expected. There are fortunately a few easily recognized natural indications that will not mislead. Where there are flowing springs of pure soft water, lime, of course, is not present, or the water would be "hard." Again, the indigenous growth of the virgin forest—the chinquepin, chestnut, hickory, beech, dogwood and oak indicate the best cigar tobacco lands, as well as the best bright plug wrapper.

PREPARATION OF THE LAND.

It should go without saying that new ground should be broken both ways with the "jumping coulter," with a blade in front to cut all roots possible, and that the roots should be raked and burned on the land. That virgin soil produces the very highest results in quality cannot be gainsaid. But if old lands are to be used they should be thoroughly mulched the summer before with a heavy crop of pea vines, which not only clothe the soil as with a garment to protect it from the sun, but absorb the nitrogen from the air, imparting it and other virgin properties to the soil. Lands thus treated should not be plowed until February, then with a two-horse plow, with a rolling colter, turn under the vines. It is better to run a cutaway or disc harrow over, to cut up the vines or other trash before plowing under. Let the land remain rough till a few days before the plants are ready to set; then dress with the cutaway or disc harrow, and lay off rows 3½ feet apart, and make a slight ridge if the plants are to be set by hand, and knock off same with a board-plow or hoe, and set plants 12 to 20 inches apart, according to variety of leaf and strength of soil. If a transplanting machine is to be used, which I always use when stumps are out of the way, the land should be rolled or dressed with a harrow, float or brush. The machine marks off the rows. There are some good machines for transplanting, notably the Bemis, made at Dayton, Ohio. Also some cheaper ones claiming merit.

WHAT FERTILIZERS MAY BE SAFELY USED.

Commercial fertilizers, as a rule, must be avoided in cigar leaf tobacco, for unlike plug tobaccos, this must have at least four essential qualities, to-wit: flavor, texture, uniform color (without white veins or calico spots), and last, but not least, burning quality. It may have all of the former in the highest degree, and without this burning quality, be utterly worthless for cigar purposes. A cigar requiring two men, one to smoke and the other to hold the torch, would not be in demand. Commercial fertilizers contain either saline or lime properties, preventing a free burn, or still other deleterious properties affecting the aroma or uniform color. That fertilizers should be used with great caution may be demonstrated by the use of German kainit, which prevents burning altogether; or hog-pen, "night soil," or goat manures, giving the "aroma" (?) of a pole-cat to the cigar. So it appears, from the foregoing, that all efforts to enrich the soil should be made with the sole view of restoring the original properties of the virgin soil, which, of course, were mainly from vegetable sources. This is helped by shading and mulching which acts mechanically to generate humus, absorb and husband nitrogen, etc., as well as to prevent the sun from evaporating these from the soil. Therefore, composts of stable, cow-pen, or barn-yard manure, with muck or cotton seed, whole or crushed, are good for cigar leaf in addition to the treatment of the old land as in the foregoing. I will give notice, however, that after many years of experimentation, I have formulated a fertilizer mainly from vegetable sources, that contains the requisite amount of potash, phosphoric acid and ammonia, and only costs $35 per ton f. o. b., and is guaranteed to promote combustion, and other desired qualities of leaf. This cigar leaf special is known as "Intense Alluvium." This is the very thing also for fine, silky plug wrappers, if one or two hundred pounds of German kainit per acre is applied to the land two or three weeks before planting time.

HOW TO APPLY FERTILIZERS.

Whether broadcast or in drills, is the question often asked. Unless the manure is well rotted and pulverized, broadcast is the better way. If strewn in the row, distribute with a bull-tongue plow or a pitchfork, so as to prevent "caking" or drying up the plant, of which there is no danger if scattered broadcast. When crushed cotton seed or cotton seed meal is used, first prepare the land well, lay off the rows, (3½ feet), then scatter broadcast and throw two furrows on the row, then what remains outside will be worked up in contact with the roots.

HOW MUCH FERTILIZER PER ACRE?

An acre of tobacco land should contain at least 100 pounds of potash ; 200 is better. If cotton seed meal alone is used, put on from 1,500 pounds to three tons per acre, according to the strength of the land. Stable and barnyard manure, or compost may be used *ad libitum*; nothing better than cow-penning. Of Intense Alluvium 200 to 1,000 pounds, or a ton on very poor land. In New England two to three tons per acre are used.

TRANSPLANTING.

When plants are three to six inches high, they are ready to be put out, in the same manner as cabbage, fifteen to eighteen inches apart in the rows, which are 3½ feet apart, but not more. If a "peg" is used, let it be short and blunt, and don't make a hole deeper than the plant is to be put in, and press the dirt closely against the roots and not the stem. The plant should be put in nearly up to the bud, however long it may be, for it cannot do well on "stilts." In order to make fine texture the land must be rich, and the plants crowded fifteen to eighteen inches, and, if new seed from Cuba, even ten to twelve inches apart in the row, so that there will be 10,000 to 12,000 plants set out to an acre. Plug tobacco should be set 2½ to 3 feet apart, in 3½ feet rows, and land should be *very rich.* ☞ It is impossible to make tobacco of fine silky texture without *crowding the plants.* Follow in three days with a basket of strong plants and a bucket

of water, if need be, in order to secure a perfect stand at once, for whenever there are missing places the plants on the border thereof are apt to be thick and "leathery."

CULTIVATION OF THE PLANT.

About ten days after transplanting, go over with the hoe, carefully removing the grass from near the plant, drawing the soil a little around it. The sweep and cultivator are the best plows to use in cultivating. Cultivate the plants while young with plow and hoe, working the soil always to the plant, and "lay by" with a hoe in same manner to keep plants from blowing down, and cease to cultivate after it has all been topped, as too much plowing and cultivating will sometimes make it too thick and leathery, for the chief aim in cigar leaf wrappers should be to make the greatest possible number of leaves to the pound. Three hundred perfect leaves to the pound would better be worth $3 per pound than 100 leaves 30c. Cigar leaf should not be plowed as much as plug leaf, as plowing makes it heavier, as the roots are pruned more than by hoeing. Aim to make, if possible, every leaf a perfect wrapper, as wrapper leaves are worth more than three times as much as imperfect leaves or "fillers."

WORMING.

The cut-worm will appear soon after transplanting, sometimes the next day. The most effectual remedy is Paris Green. Mix one tablespoonful with a gallon of corn meal or flour, and sprinkle the plants, using a perforated tin can as a pepper box. The bud-worm appears next. Use Paris Green in the same way. The horned worm appears first about the first or middle of May. This is the first "crop" to be dreaded, but not so serious as the next "crop," which does not appear in Florida till about the full moon in July, by which time I aim to have most of the tobacco safely housed. The best remedy for this great adversary to the tobacco crop is cobalt dissolved in honey or syrup diluted, putting a few drops into some jimson (Jamestown or stramonium) blossoms placed around the border of the field about sunset, on small pieces of board with a few holes, nailed on sticks three and a half feet high. One moth, "tobacco fly," destroyed thus would deposit some 450 to 500 eggs, which hatch in about seventy-two hours. It requires twenty-one days for the horned worm to mature, when it goes into the ground to come forth again in twenty-one days (in summer) another moth to perpetuate her posterity. The common wasp, dirt-dauber, yellow jacket, hornet, etc., are the best friends of the tobacco grower. I have estimated that one red wasp would earn fifteen cents daily in a tobacco patch. By all means foster and care for them, but do not trust them to take all the worms off. You must imitate the bird, and catch the worm before the noon sun drives him to a hiding place. I have learned not to use torch fires at night to destroy moth, as more of our friends than enemies may be destroyed by them.

TOPPING AND SUCKERING.

As soon as the blossom appears well, break it off, leaving fifteen to twenty leaves. On plug tobacco leave ten to twelve leaves only, not counting the sand or ground leaves, which some "prime" off, but if the land is sandy leave them on to protect the upper leaves from sand. If the bud-worm has attacked a plant, and injured it seriously, cut it off near the ground and let a sucker take its place, which will do well surprisingly soon. All the plants will not do to top at once, neither to cut at once, unless the later topping is made lower, which causes the leaves to spread and grow too large.

"Suckers" will soon appear after topping, which must be broken off when three or four inches long. Some varieties put forth the second and third sucker, some only one crop. The Vuelta Abajo is ready to cut after the second crop of suckers is removed.

Tobacco is ripe and ready to cut when yellow spots begin to appear on the surface of the leaves, or when it will snap or break when pinched between the thumb and finger. Cigar leaf, unlike plug leaf, should not be *over-ripe*—better cut a day or two too soon than to let it get over-ripe.

HARVESTING.

The plant should be cut with a sharp, strong knife, *entire* and not split, as some do. By no means break off the leaves in the field, except the Sumatra Wrapper or old Florida Speckled Wrapper, which grow much taller and bear many more leaves than the Vuelta Abajo or other types. Leaves thus gathered seem to *die*, as it were, losing both elasticity and brilliancy—besides, this old method is too tedious and expensive. I am aware that gathering the leaves in baskets was once popular in bright plug tobacco districts, but is now being abandoned by many. In some respects cigar leaf needs the very opposite treatment from plug leaf, *i. e.*, the former should run two or three hundred leaves to the pound, the latter twenty to thirty. The former needs humidity all the way through from the seed to the cigar, and often water is used to wet the barn floor, whereas the other needs a furnace. Cigar leaf must be bulked almost damp, the other almost dry, so let no one be led astray by agents of patent barns and flues from plug districts, or laborers therefrom. My own experience in Virginia, North Carolina and Kentucky, misled me in my first experiments in cigar leaf.

Never cut tobacco while the dew or rain drops remain on the leaves, as black spots will result. I prefer to cut in the afternoon, as the sun is getting weaker for in the forenoon, unless cloudy, there is danger of sunburn, which will result in ten minutes just before noon. Before and after the plant is cut be careful to remove every worm, as they will destroy the tobacco if taken into the barn, *i. e.*, cigar leaf to be air-cured. If the ground has not been cultivated for two or three weeks before cutting, there will be a nice carpet of grass on which to lay the tobacco when cut; don't lay it down in the sand or dirt—select a shaded grassy place and after it has wilted so as not to break, lay it very carefully on the straw on the floor of the wagon, and when a medium load is on, cover with a sheet or some weeds, so as to protect it from the sun while en route to the barn, where it must be placed on some straw or a rug very carefully, till the hand who must remain there has speared it on the laths and put it closely up on the bottom tier poles where it may remain till next noonday, when it should be carried up and adjusted on the upper tier poles. It should be put about six inches apart on the laths, and they about seven or eight inches apart on the poles.

CIGAR TOBACCO BARNS.

All barns should be convenient to the tobacco field. For cigar leaf, never build one less than thirty feet wide and sixteen feet high at the sides, and as long as you please. You cannot let tobacco remain on the bottom tier poles in this climate, as it would be liable to mould in wet weather. A barn thirty-two by fifty, with sixteen feet posts and siding, is sufficient for five acres, ordinarily. The first cutting may often be stripped and boxed to make room for the last cutting, as it will do to strip in thirty-five to forty days if not very large. The tier poles should be ten to twelve feet long.

Pine poles four or five inches in diameter, removing the bark with drawknife, make the best poles, and even good rafters. The posts should be 4x6, if sawed, and put on sills, which is the best on the outside. The two rows on inside (for there should be four rows of posts to have three spaces—a driveway in the middle) may be cut from the pine or cypress forests and placed on the ground. The middle posts should be twenty feet long to give pitch or slope to the roof. The eaves should project twelve to eighteen inches, also the gable roof. The roof must be ventilated at the top, so as to allow the hot air to escape, otherwise the tobacco will char or "pole burn" near the roof. The laths should be four feet and two inches long—poles four feet apart, and three and one-half feet one above the other—the first one five and one-half feet from the ground floor. Windows should be made between each post, which should be eight feet apart. They should be as long as possible and the width of three boards, say thirty or thirty-five inches wide and eight or ten feet long, hung with strap hinges on top to push out at bottom every night and close every dry day while tobacco is hanging.

Barns for curing plug tobacco may be built of logs cheaply, twenty feet high, and daubed with clay. The entire cost of a barn twenty by thirty, and twenty feet high, need not exceed $35 to $50, including the furnace and flue pipes. One flue barn out of four is sufficient, as the tobacco may be cured in forty-eight hours and removed to the stripping barn, which should have a cellar or "ordering room" near or under the stripping floor.

STRIPPING AND BOXING.

Cigar tobacco is ready to strip from the stalk even before all the green has disappeared from the stalk, but not until the stem of the leaf is cured. By opening windows every night in July and August in Florida the tobacco will be soft or "in case" every morning, when enough should be taken down and covered to last the strippers for one day. Beginners should make only three or four

GRADES OF CIGAR LEAF.

First, wrappers (perfect leaves); second, binders (partially perfect leaves); third, filler (ragged and all imperfect leaves). The fourth grade should be the trashy leaves which, if sold at all, should not be included with the crop. Always give the lower grade the benefit of the doubtful leaf. The best plan is to take off all the imperfect leaves first, leaving those with apparent wrapper qualities for more critical examination. Bind in "hands" (or bundles) of twenty to thirty leaves of even length and quality, and keep under cover till noon or evening, when it must be put into the boxes straight and compact, lapping tips about six inches, and let the butts be about one inch from the ends of the box so as to allow the heat from the sweating process, which begins at once, to escape. Keep tobacco in boxes covered with cheap oil cloth while stripping, as a case or box may not be filled for several days. When full fit boards and press down by standing on boards, or a small lever may be used. When the box is full it is ready for the local buyer, who expects to re-handle it in his own warehouse (until the average Florida tobacco grower has learned to grade more accurately) and sweat and otherwise prepare it for the manufacturer, or the greater markets of this and foreign countries. It pays the farmer better to sell quickly and take a few cents less and let the local dealer re-handle and grade more perfectly, and sweat it or "*betune it,*" thereby relieving the planter of a task he cannot well perform; if indeed they will pay him a fair price, otherwise he would better have it sweated or "betuned" and prepared for the manufacturer. Sometimes one hundred to five hundred per cent may be saved in this way.

These rules for stripping, boxing, etc., do not apply to bright plug leaf tobacco, which is to be "prized" into hogsheads of 750 to 1,000 pounds. Kiln-dried tobacco will not keep sound if the stem is soft when bulked or prized; the stem should snap when bent between the fingers. Air-cured tobacco may be boxed when quite damp, for the fabric of the leaf, the cellular tissue has not been broken down by intense fire heat, as it is of the kiln-dried or flue-cured.

Never undertake to soften or bring tobacco in case to strip or handle by "sprinkling or pouring," much less by "immersion." Nevertheless, if the weather should be dry and windy, and should so continue, your crop will be in great danger (in Florida) of injury from evaporation and deterioration becoming dry and harsh or "bony and crusty." It should be put into the cases (boxes), which should be two or two and a half feet wide and deep, by three or three and a half feet long (but not made of pitch pine, as it will impart the turpentine odor), by or before the end of October or November (unless it is a fall crop, which is possible). It is important, to obtain the best results, to put *Florida* cigar tobacco in the boxes before its "*life blood*" has been evaporated by hanging too long on the poles. In other words, its inherent moisture (sap) should be conserved by early stripping and boxing, for therein consists the secret of preserving the life, aroma, brilliancy, and elasticity of the article, which keep it soft, rich and mellow, besides preventing its corruption and consumption by moth and rust; for if this rule is not observed, and the tobacco is put up in a declining condition, so it will continue until for a year or two, when the little white worm, sometimes seen in old cigars made of poor, lifeless tobacco, will attack and consume it. Here, then, is a dilemma if the weather is dry and windy, and the question arises

HOW TO SOFTEN THE TOBACCO

without spraying or sprinkling, which would often ruin it. For $5 or $10 (or none if you do the simple work yourself) you may have a *softening room* in one corner of your barn, or on the outside, by digging a pit about 5 feet deep, by 10 or more square, in the ground. If clay, no wall of logs, boards or brick is needed. Build above ground about 3½ or 5 feet an air tight wall. The roof may be nearly flat, but may be covered with the earth taken out of the pit. Have only one opening or door. Put tier poles or light strips in this room, and place on them a sufficient quantity of tobacco to strip next day. It will become soft and pliable in one night.

BRIGHT PLUG WRAPPER.

It has already been demonstrated that Florida soil and climate are probably better adapted to the production of fine bright plug wrapper, "cutter" (cigarette), and pipe tobacco than even Va., N. C., or S. C. The soil, climate, seasons, and immunity from storms and frosts, which very often cut short the crop in those States, make Florida, especially North Florida, preeminently the *New Eldorado* of the U. S. for growers of these types of tobacco, and the fact that they always command a ready cash market at from 10 to 100 cents per pound should stimulate the growing of them extensively in Florida. Scores of young men from Va. and N. C. are ready to come to Florida for this purpose at fair wages. Any practical farmer can learn it in one year by close application. The foregoing instructions on cigar leaf from the seed-bed to setting it out, are applicable to plug tobacco, which should be planted about 3x3½ feet, and topped at 10 to 12 leaves. This and the curing process and the "prizing order" or case, constitute the main points of difference.

The only reason for flue curing or kiln-drying, is this: Everybody knows that the green foliage of trees and plants must turn yellow before it gets "brown and sear." Now the object of the flue or furnace is to raise the heat in the barn rapidly, when the tobacco has turned yellow, and fasten the yellow color in the leaf and stem within 48 hours or less; then it may be removed into the stripping barn, and the flue barn may be used for the next cutting.

PLUG TOBACCO BARN.

These flue barns may be built of logs or boards 1x10 or 12 inches, 18x20 feet, and 20 feet high, closely battened. They may be daubed with clay. The expense need not exceed $35 to $50. The furnaces may be built of brick or rock each side of the door 18 to 20 inches high and about 6 feet long—opening under an arch or heavy sheet iron top from the outside, in which the fuel is to be burnt. The flue pipe, 10 or 12 inches in diameter, is connected with the furnace reaching to back side of the barn and returning parallel, through the wall near the door and turned up about 6 feet for chimney. A thermometer must be used to regulate the heat.

It will be necessary in a future bulletin to give more minute details in curing, bulking, grading and "ordering' i. e., the proper *order* or case in which this kiln-dried leaf must be prized into hogsheads to insure its safekeeping. At this point cigar leaf growers and manipulators would surely "slip up," as intimated above.

I omitted to state that the best types of bright plug leaf are the Long Gooch and White Stem Orinoko. They can be bought of the Raglan Seed Farm, Hyco, Va., at about $2.00 per pound, and they can be relied on as fresh and genuine; or may be had by applying to the Commissioner of Agriculture, Hon. L. B. Wombwell, Tallahassee, Fla.

NOTES.

1. Page 118. Sumatra seed, being more tropical, should not be sown in north Florida till February 1st to March 1st, and the beds should always be covered with canvas to keep a more even temperature. It is thought that this type should be planted about a month later than others mentioned.

2. p. 121. The effect of limestone on tobacco should be better understood. Between the lower Silurian and upper Carboniferous strata there are many different limestones, which differntiate the soils by their disintegration. I see that some Cuban experts are looking for Calcareous surface rock as indication of tobacco lands that will give combustivity. They will find, perhaps too late, that the Andean oolite rocks of Cuba affect the soil quite differently from the massive rotten limestone of Florida. In a future publication this relation of geology to botany as it affects different types of tobacco, will be more fully discussed.

3. p. 127. If enough cotton-seed meal be used to get, say 150 pounds of potash per acre, the meal would yield so much nitrogen that the leaf would be darkened, and every one knows that dark leaf of equal quality will not command half as much as light colors.

4. p. 130. To the direction not to break off leaves in the fields, the Sumatra and old Florida wrapper may be an exception. They grow much taller and in order to secure the bottom leaves before the top ones ripen they should be "primed off" and taken in larg flat baskets to the barn, and strung on slender laths, cord, or wire. I prefer wire, cut into fifteen inch lengths and pierced through the large end of the stem, the leaves being put face to face or back to back, not "spooned." Put three of these astride the lath or stem and hang on poles.

5. p. 134. "Kiln-dried" or "flue-cured" will not stand the moist ferment or sweating process necessary for cigar leaf. It would very soon "funk", blacken and rot, for the fabric or cellular tissue was destroyed by the intense heat. This subject is important, and will be discussed in future.

Bulletin No. 31. December, 1895.

FLORIDA

AGRICULTURAL EXPERIMENT

STATION.

SOME MARKET VEGETABLES FOR FLORIDA.

P. H. ROLFS.

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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SOME MARKET VEGETABLES FOR FLORIDA.

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SOIL.

The light sandy soil and sandy loam of Florida are particularly well adapted to the production of vegetables. These soils will produce an abundance of early vegetables in whatever locality they may be found. These soils also give up their fertilizer readily, hence respond quickly to any change in the necessary elements. We may, by judicious selection, find nearly an ideal soil for this purpose in every county of the State. There are, however, other conditions, as those of temperature and moisture, that need to be taken into consideration.

Sandy soil and sandy loam give up water readily, so in many localities we have thirsty land; again under other conditions the land becomes "water sobbed." Soil that is too dry or too wet is not fit for vegetable growing. Careful mechanical analysis shows that there need not be any difference in structure between thirsty land, "water sobbed" and good vegetable land. The difference may be one of water supply. It should not be understood that if all thirsty land were irrigated it would make good vegetable land, nor that all "water sobbed" land if properly drained would make good vegetable land.

Prof. Whitney has shown that (p. 136, Year-Book, U. S. Agril. Dept., 1894,) the variation in size of the particles that make up different soils is very great, and when soils are classed as the same, in common usage, as, for instance, the high pine land soils, there may be a wide difference in the size of the grains, and also in the power for retaining moisture. He remarks, "It will be seen (from the table) that the Florida soils contain very little silt, fine silt, or clay, the whole amount of these three grades being less than five per cent. They are extremely light-textured sandy soils, adapted to the earliest spring vegetables."

HOT BEDS.

This very convenient form of plant-bed is not as generally used in Florida as it merits; probably from the fact that many persons do not understand the principles underlying a successful operation of the same.

When any undecomposed manure, leaves or other vegetable matter begins to decay, a certain amount of heat is given off; if the pile is large and in a compact heap the amount of heat evolved will be considerable. This is due to the breaking down of plant tissues through the actions of low forms of life, such as bacteria and molds. This breaking down takes place in the presence of moisture; vegetable matter stored in a dry state will remain undecomposed for an indefinite time. Any application of this fact will make it possible for every one who keeps a horse or a cow to provide himself with a hot-bed.

During the early part of the season the manure may be stored away dry, and kept so, and when the time to fix a hot-bed comes it may be prepared.

SELECTION OF A LOCATION.

Four points should be borne in mind when one is selecting the place for a hot-bed:

First, it must be sheltered from cold winds, that is, it should be in a warm spot; there should be a wind-break of some kind, the bed should be and free to the full sun all day; the south side of a barn may be used in some cases.

Second, it must be protected from rains; the drippings of eaves must be carried away and the surface drained so that water will not run under.

Third, water must be handy, or the needed supply may not be applied.

Fourth, it must be near one's house or near his daily work, so as to require the least possible time to look after it.

CONSTRUCTION.

In States north of Florida it is quite necessary to use glazed sashes in building hot-beds. These come in sizes of 3x6 feet, and can be had in large markets for about $1.50 apiece. In northern Florida these will be found to be quite useful, but for central and South Florida they are not needed often enough to warrant one's investing in them, except for special purposes. Last winter has been acknowledged generally to be the coldest that Florida has had for many years. The temperature on the college campus went down to 13½° F. During the freeze there was a hot-bed containing egg-plant seedlings covered with two thicknesses of best protecting cloth; the seedlings, eight inches away from the edge of the bed, were not frozen. Many seedlings of other vegetables were not frozen under a single thickness of protecting cloth. It can be stated therefore with confidence that in ordinary winters protecting cloth will be sufficient to keep plants from freezing even in North Florida. It is not the intention to give the impression that sash are not better than cloth, but that we have so few nights and sunny days which are cold enough to injure plants that it is more economical to use the protecting cloth.

The hot-beds used in the Experiment Station garden are six feet wide, and long enough to suit the particular use. All material used in their construction is one inch thick. The back or north sides are 26 inches high, and the south sides 10 inches high. When glazed sash are used a pitch of four inches is sufficient; that is, the front is made 10 inches high and the back 14. But experience has taught us that this pitch is not sufficient for frames covered with plant-cloth. The sides are nailed to 4 inch pieces that were driven into the ground six feet apart. The ends of the frame of are trimmed to an even slope. At intervals six feet, three inch pieces are dove-tailed into the front and back, to steady the sides, and to hold the protecting cloth from bagging.

The protecting cloth is sewed into a sheet large enough to cover an entire frame. The seams run crosswise for obvious reasons. The sheet is fastened to the back and then stretched over the frame; and just far enough over the front to press the cloth down tightly, a strip is nailed to serve as a roller for a curtain. By turning at one end the whole curtain may be raised and fastened at the top; when it is wanted for use the fastening is loosened and the curtain unrolls itself, at the same time shutting the whole frame up for the night. The wood work and cloth for a frame six feet wide and thirty feet, long should not cost more than $2.50.

USING THE MANURE.

When the frame for the hot-bed has been completed the undecomposed manure is placed in it to the depth of six to ten inches. It is usually necessary to remove some of the earth inside of the frame; this can be used to bank it on the outside. As the manure is placed in the frame it should be thoroughly soaked and tramped down. In two or three days this will begin to heat, and will continue to rise in temperature for eight or ten days, and often will rise very high, running considerably over a hundred degrees. If the bed is kept moist, and this can be tested by digging into parts of it, there is no danger of its "burning." This does not mean that there is ever any danger of it actually generating fire, but the stuff becomes dry and discharges valuable fertilizing quality as gasses and hence is about destroyed. When large quantities of fresh manure are used the gardeners dump it in piles, and fork it over every day or two to keep it cool enough, and at the end of ten days or two weeks place it in the hot-bed.

After the manure has been placed in the frame an inch of rich loam should be spread over it, to arrest any gasses that may be escaping. After about ten days of fermenting the manure has reached its highest temperature, and seed can be sown in the loam without danger. From this time on the temperature falls gradually until decomposition is complete.

The only advantage a hot-bed has over a cold-frame is that the decomposing manure gives off heat, and the amount of heat given off will vary with the amount of manure used. If one desires to keep a bed extra warm the frame may be banked with fresh manure.

PREPARING A COLD-FRAME.

The frame work and cover are prepared in the same way as for hot-bed. Cold-frames require less fertilizer, and hence are cheaper than hot-beds. The soil in them should be made very fertile by using commercial fertilizer, or preferably compost. Make the soil about six inches deep, using about as much well-rotted compost as earth. The fertilizer must be worked in thoroughly, and the frame thus prepared allowed to stand ten days or two weeks, all the time keeping it thoroughly wet. A cold-frame is as valuable in the summer as in the winter. In the summer the cloth is raised to allow air to pass under, thus protecting small plants from the scorching sun. In the management of a cold frame, and of a hot-bed, plenty of water is indispensable, and it must be applied in liberal quantities daily.

PREPARATION OF A PLANT-BED.

Plant-beds are very largely employed in this State for raising seedlings, especially tobacco. A cold-frame will serve the purposes of a plant-bed for raising seedlings, and has many advantages. Seedlings, after growing to a size that are easily handled are often planted in a bed for further maturing; this is especially so when large quantities of tomato, cabbage or celery plants are wanted. The advantage of having these plants in as small a space as practicable is apparent to all. The plant-bed must be very fertile, and have plenty of water to be used in case of need. The ground should be raked carefully, the fertilizer applied, and the bed spaded or plowed, and then raked again. The bed should lie a week or ten days, to allow the fertilizer to be incorporated, when the plants may be set out. Plants should not be allowed to become checked in their growth at any time. It does plants good to be planted several times, and with some vegetables such frequent planting is profitable; but for plants to come to a standstill for want of water or fertilizer works a detriment that is strikingly noticeable in the crop. Hence in the transplantings great care should be taken as to moisture, temperature and soil, so that growth may not be checked.

FERTILIZERS.

This subject has been thoroughly and clearly discussed by my colleague, Prof. A. A. Persons, in Bulletins 20 and 22 of the

Florida Agricultural Experiment Station. Any one finding difficulty in preparing formulæ of fertilizer herein mentioned should consult these Bulletins for information. In this Bulletin formulæ of fertilizers are given in the discussion of particular crops.

Vegetable growers having only a few acres will doubtless find it cheaper to have the fertilizer mixed at the factory, but those who cultivate large areas of one kind of vegetable should be able to save the profit that the manufacturer makes on mixing the fertilizer.

BEAN.

The bean is a tender annual and does not grow to perfection in cold weather. Its value as a food has long been recognized, but the people in this country are slow in adopting it as food for animals, though for household consumption it is used extensively. In Europe and Asia it is used largely for fodder. The main reason for its not being used more extensively in the United States is that much time is consumed in gathering the crop. As soon as we are able to harvest it by horse-power we shall probably use it largely as a feed for domestic animals. Seedsmen divide beans into two classes, the bush beans and the pole beans. Each of these classes requires quite different treatment. We will consider the bush or dwarf kind first.

BUSH BEAN.

This is the kind that is used for shipping purposes as green snap-beans or snaps. In some portions of this State the growing of string-beans is a lucrative class of gardening. All beans are very tender and sensitive to cold, even when it is not severe enough to freeze. Only those portions of Florida that are free from frosts and long cold spells can grow them for mid-winter market.

SELECTION OF SOIL.

For early or winter market a light sandy soil should be selected, and this should be well manured. While beans are able to add nitrogen to the soil, they cannot produce a good crop in a soil that is deficient in this element. When the beans are about half grown is the time to pick them for market, for by this time the pods have attained nearly their full length. The picking must be done after the dew is off, and the pods and plants are dry. After allowing them to lie a short time, say an hour or two, to lose their crispness, they are ready to crate. The usual crate holds about a bushel, and is partitioned. In crating, the pods are straightened out more or less and laid into the crate lengthwise. When the crate is full the top is pressed down firmly and nailed.

When the crop is to ripen, the hills are planted about twice as far apart in the row. The cultivation in either case is the same; that is, they are plowed as long as the vines will permit. There is a good market for dry beans, but that is usually overlooked by our gardeners. The vines that have been picked over several times for string-beans rarely produce enough dry ones to pay for the gathering. When they are raised to sell dry, they are cut off with a mower or scythe like hay and cured, then raked together, piled and stacked. The threshing may be done by a separator or flail. The use of the threshing machine makes the labor of producing a crop quite small, but it breaks so many beans that they often have to be sold for 40 per cent of the price paid for the flail threshed ones.

If the crop is planted for string beans the rows are made about two feet apart, and the hills about six inches apart in the row. From one to four plants are allowed to grow in a hill; depending on the strength of the soil. The hills are planted farther apart if the variety is one of the larger bush-beans. It should be the aim in planting to get the row as narrow as possible; it is better to drop a bean every inch than to drop six beans every six inches, provided it can be accomplished as easily. When the rows are narrow there is much less land that has to be worked by hand. When the rows are straight and very narrow it often happens that there is no occasion to use the hoe at all. Excellent crops of beans are grown without taking a hoe into the field at all.

In planting, care must be taken not to use diseased nor buggy seed, as the pods may be badly damaged before picking or they may be spoiled on the way to market. In picking, separate all culls from the good ones at once, to prevent the inoculating of sound pods with the diseased ones. The culls and spotted pods should be picked and removed from the field to be destroyed.

HOW PLANTED FOR IRRIGATION.

When the land can be irrigated deep double furrows should be plowed. This will throw the field into ridges about thirty inches across the top. Two rows of beans may be planted on each of such beds. This deep furrow serves as guide or trough for water and also as a good drain during rainy weather.

VARIETIES.

The earliest and hardiest is the Mohawk. A good green podded variety is the Valentine. A much prettier variety for table use is the Golden Wax. The larger portion of our crop is of the green varieties, as they are considered hardier and the seed more generally distributed and cheaper.

POLE BEANS.

The pole beans require a much richer soil than the bush beans and are rarely used for shipping purposes. These beans are more desirable for family use, but are somewhat later in maturing, so both kinds should be planted for home use. The pole limas are very desirable, but there is much difficulty in the pods setting. Long rows of very fine vines have been grown at Lake City without producing a mess of good beans. The bush limas produce a fine crop however.

The early preparation of the soil is the same as for the low growing forms. Lay the land off four by four, or six by six feet, fertilize the checks thoroughly, and after the fertilizer is well incorporated plant the seed. Plant from one to four beans to the hill; vary the number of plants to suit the strength of the land. Such ordinary care as given the garden crops will be sufficient. As soon as the vines begin to run they should be staked. In this matter it is best to set the stakes so the tops of four will come together, and tie them; in this way they will support one another. By staking them in squares the space between the rows arched together must be cultivated by hand, but the vines will soon shade the ground, so preventing much further growth of weeds.

In fertilizing for a bean crop the material should be applied broad cast, as the bean roots will go a long way in the soil. There is danger of having it too concentrated if one applies it in the hill. The bean is a gross feeder, and will grow on land that is too raw for the ordinary crops.

FERTILIZER FORMULA.

Available phosphoric acid	7 per cent.
Potash	7 per cent.
Nitrogen	3 per cent.

Use 1,000 to 2,000 pounds per acre. If the land is rich in vegetable matter the nitrogen may be omitted; in such a case only phosphoric acid and potash need be applied.

HOW TO MIX FERTILIZERS.

Let us consider how we can prepare fertilizer equal to a ton of the above formula. Our formula calls for 7 per cent of phosphoric acid. This simply means that we want 140 pounds of available phosphric acid to the acre (140 pounds being 7 per cent of 2,000 pounds—a ton). Doubtless the cheapest source of this element is our acid phosphate or super-phosphate. This usually contains from 10 to 14 per cent of available phosphoric acid, or, stating it in other words, every hundred pounds of acid phosphate contains from 10 to 14 pounds of available phosphoric acid. Now, if our phosphate contains 10 per cent available phosphoric acid, it will take 1,400 pounds to supply the desired amount. If the phosphate analyzes 14 per cent it will take 1,000 pounds. Dissolved bone contains from 13 to 15 per cent of available phosphoric acid. If the fertilizer at hand is a 13 per cent one it will take 1,077 pounds to supply the desired amount of this element; if a 15 per cent one, 933 pounds. There are other sources of phosphoric acid, but these two are the more common in our markets.

Potash may be obtained from various sources. A high grade of sulphate of potash contains from 50 to 55 per cent of potash. To make up the 140 pounds (7 per cent of 2,000 pounds) desired, it will take from 254 pounds (of the higher per cent) to 280 pounds (of the lower per cent). A low grade of sulphate of potash contains from 27 to 30 per cent of potash; 518 pounds (of the lower per cent) to 466 pounds (of the higher per cent) would be required. Kainit, which is a still lower grade of sulphate of potash, contains about 15 per cent of potash. Of this it would require 933 pounds. Muriate of potash contains about 50 per cent potash. Of this it would take 280 pounds to supply the desired amount.

Nitrogen may be obtained from sulphate of ammonia, which contains from 19 to 22 per cent of this element. As 60 pounds (3 per cent of 2,000 pounds) are called for by the formula, it will take 314 pounds (of the lower per cent) or 272 pounds (of the higher per cent). Nitrate of soda contains from 15 to 16 per cent of this element; so it will take 400 pounds (of the lower per cent) or 374 pounds (of the higher per cent). Dried blood varies from 10 to 15 per cent of nitrogen; so it will take 600 pounds (of the lower per cent) or 400 pounds (of the higher per cent). Cotton-seed meal may contain 8 per cent nitrogen; of this grade it would require 759 pounds to supply the desired amount. The amount of potash and phosphoric acid in cotton-seed meal is small, so it has not been taken into consideration.

Concentrating these statements, we may use, to obtain the desired amount of phosphoric acid:

Phosphate	(available phosphoric acid,	10 per cent)	1,400 lbs., or
"	" " "	14 " "	1,000 " "
Dissolved bone	" " "	13 " "	1,077 " "
" "	" " "	15 " "	933 "

To obtain the amount of potash desired:

Muriate of potash	(50 per cent potash)	280 lbs., or
Sulphate "	(55 " " ")	254 " "
" "	(50 " " ")	280 " "
" "	(30 " " ")	466 " "
" "	(27 " " ")	518 " "
Kainit	(15 " " ")	933 "

To obtain the amount of nitrogen desired:

Sulphate of ammonia	(22 per cent nitrogen)	272 pounds, or
“ “	(19 “ “ “)	314 “ “
Nitrate of soda . . .	(16 “ “ “)	374 “ “
“ “ . . .	(15 “ “ “)	400 “ “
Dried blood	(15 “ “ “)	400 “ “
“ “	(10 “ “ “)	600 “ “
Cotton-seed meal . .	(8 “ “ “)	750 “

By selecting one amount from each of the three required fertilizer elements we should have a complete fertilizer, and the amount of each element desired, though we should not necessarily have a ton of fertilizer. To illustrate, let us take:

Dissolved bone (15 per cent avail. phos. acid)	933 lbs
Sulphate of potash (55 per cent potash)	254 lbs
Sulphate of ammonia (22 per cent nitrogen)	272 lbs
Total	1,469 lbs
To get a ton, add earth	531 lbs
Total	2,000 lbs

Again:

Acid phosphate (10 per cent avail. phos. acid)	1,400 lbs
Kainit (15 per cent potash)	933 lbs
Cotton-seed meal (8 per cent nitrogen)	750 lbs
Total	3,083 lbs

If our calculations have been correct, these two fertilizers should be equally valuable to the land, though the latter contains more than twice as many pounds as the former. The per cent of the different fertilizer elements in the two fertilizers will be found different from those suggested in the formula, but the number of *pounds* of each *element* are just what the formula calls for. In case the earth is added the fertilizer will continue just the per cents called for in the formula.

Both of these fertilizers are faulty; the first has all the nitrogen in a soluble form, which is easily washed out of the soil by rains, and before the "snaps" are ready to be picked the plants may be suffering for want of this (nitrogen) element. The second fertilizer has all its nitrogen in the form of cotton-seed meal, which would not be available to the seedling, especially during cold, dry weather. A better fertilizer would be obtained by using 580 pounds of cotton-seed meal and 68 pounds of sulphate of ammonia (22 per cent nitrogen) to supply the desired amount of nitrogen.

BEET.

This vegetable is not grown extensively in Florida for Northern markets. It ships well, and sells easily, but our market gardeners have not learned to be satisfied to raise crops on small profits. By Northern gardeners it is regarded as one of the important vegetables for early market, and for bringing a quick return. It is merely a question of time until the gardeners of our State will turn their attention to the beet.

Soil and Preparation.

A soil that is well adapted to growing the usual vegetables will be found good for this one. It may be slightly heavier than that for the crops that are grown for their foliage, as lettuce. A good cabbage soil will be found of about the right consistency. Wet or soggy land will not raise a crop. Plow deep and prepare the ground well; the seedlings are quite small and need considerable coaxing before they will make a good start. Use plenty of fertilizer of some well prepared kind. Rough or undecomposed material should not be used. Along the row some nitrate of soda or guano should be scattered to give the seedlings a quick start, and to form a good root system to tide them over a possible dry spell.

Seeding and Cultivating.

It is not profitable to transplant beets; it may be done on a small scale, but it is too expensive to practice on a large scale. Sow the seed in drills about twenty inches apart. The seed should be sown thick enough so that a half or two-thirds of the plants may be weeded out. Do not thin the plants until they begin to crowd one another, and then thin to four or six inches in the row. The best time for thinning is when the seedlings have reached a size of two inches; if the seed has happened to grow well it may be necessary to thin them out before this time.

The time for sowing will depend upon conditions of weather. They should be sown, however, early enough, so a good start may be had before the cold of winter is expected. In the latitude of Lake City, if the weather is favorable, near the first of November is a good time.

If the seed has been sown in a wide row, and this is to be commended, it will be necessary to do considerable hoeing. The ground in the row should never be left to become hard, but be kept mellow; this will let the fleshy roots sink into the soil instead of forming on top.

MARKETING.

The usual method is to use barrels or large boxes; this is a clumsy way, and one not calculated to bring the best price. The usual vegetable crate will be found handy and desirable.

In districts where there are pickling factories, and near large cities, small beets, with greens, are raised with profit, but these cannot be shipped to a distant market. For a distant market gather tops and all; carry to the packing-house; remove the tops with a sharp knife, leaving about an inch of the leaf-stalk on the beet. Remove the dirt, and pack in vegetable crates. The leaves put in a compost heap will pay for the trouble of hauling, or they can be fed to domestic animals with profit. The beet itself makes one of the best feeds for milch cows, and is excellent for other domestic animals.

VARIETIES.

Extra Early Blood Turnip, Eclipse and Extra Early Egyptian are good varieties to grow for market. The first named is probably the best; the last named has the disadvantage of becoming stringy if it matures during a long dry spell, or if allowed to stand too long. The deep red varieties are preferred in the markets, and those that are turnip shaped sell better than the long.

FERTILIZER FORMULA.

Available phosphoric acid	6 per cent.
Potash	7 per cent.
Nitrogen	6 per cent.

Kainit, sulphâte of potash or muriate of potash may be used as a source for potash. Twelve hundred to two thousand pounds will not be found too much to produce a good crop.

CABBAGE.

The season for marketing cabbage is not long, because the Maine and Nova Scotia cabbage will keep until March or April, while the spring crop of Georgia and South Carolina begins to reach market in June. Some years the Northern crop is small; in such cases, late winter cabbage commands a high price. If at the same time the potato crop is light, there will be a demand for Florida cabbage. Often the vegetable grower can anticipate such conditions, and put in a large crop of cabbage. There is a large Southern market that would depend on Florida for cabbage if the supply were constant. An extensive trade has already sprung up with New Orleans.

Cabbage is an excellent crop to feed to cattle. In some of the dairying districts it is raised as a second crop with a view of feeding to milch-cows.

SEED SOWING.

This is probably the earliest vegetable to grow from seed that we have in the market. It is not necessary to have a cold-frame to start the seedlings, but success is more certain by using it. The bed used to raise the seedlings need not have bottom heat, and need not be as fertile as for most other seedlings. To produce stocky plants, it is better to have the bed rather cool. If one discovers that the plants are not progressing rapidly enough to bring them to the size desired by transplanting time, they can be stimulated to rapid growth by the use of some liquid manure, or some cotton-seed meal. The latter must not come in contact with the plants, as it is liable to cause a "damping off" in the seed-bed when it begins to decay. One-half ounce to an ounce of seed should give plants enough for an acre.

SOWING THE SEED.

It is preferable to sow the seed in drills, far enough apart to permit them to be worked either by hoe or hand-plow. In our latitude, July, August or September, depending on the variety, is the right time to sow for spring markets of the North. This will bring the crop into market after the Northern stored crop has been consumed, and before the early spring crop has matured. The drills are made about three-fourths of an inch deep. As soon as the seedlings begin to break through the ground, make a liberal application of tobacco dust; repeat the dusting every three or four days. This will kill or drive away some insects that are quite numerous at that time of the year.

If the seeds grow well the plants become crowded in the drills. In this case a portion of them may be shifted to another bed, if it is desirable to save them; otherwise they should be thinned out. The plants should not be allowed to grow more than five or six inches tall, nor is it well to keep them in the seed-bed until they grow to this size. They can be checked in their growth by withholding water, and by shifting them several times; the latter is an excellent practice, though rarely followed.

SOIL.

Cabbage is a gross feeder, and will succeed on soil where many other crops fail. The soil for ordinary gardening is considered excellent for this vegetable. If the land is not level, a northern slope is preferred, as that is cooler and keeps a more nearly constant temperature. The freezes of last winter killed small cabbages in the field, which would have lived with only a slight protection, nor would they have been killed if the plants had been older. The seedlings, or plants in the plant-bed, can stand about 20° F.

PLANTING AND CULTIVATING.

Before transplanting it is well to harden the plants off, and when one is ready to remove them, soak the ground thoroughly; this will cause the soil to adhere to the roots better. A rainy time is preferable for planting them out, and this can usually be waited for in our State, though it is not really necessary, as the plants grow very readily. For medium to large varieties, make the rows three feet apart, and put the plants two or three feet apart in the row. They should be planted with a view of doing all the cultivating by horse-power. If the season happens to be dry, be sure to give frequent and thorough cultivation, to conserve the moisture in the soil.

It is to be regretted very much that we do not supply our home market. A rather striking case occurred in the spring of 1894. The grocery men at Lake City bought cabbage from New York, and retailed it at ten cents ahead. At the same time a vegetable grower in Manatee county was shipping cabbage by the car-load to St. Louis, Mo., at a loss of fifteen dollars per car-load.

FERTILIZER FORMULA.

Available phosphoric acid	7 per cent.
Potash	8 per cent.
Nitrogen	5 per cent.

Cabbage has very little choice as to the source of the fertilizer, but it wants abundance of it. An acre requires 1,500 to 3,000 pounds, according to the kind of land.

MARKETING.

There is no settled form of package for cabbage. The smaller early cabbage is usually crated or barreled; the fall cabbage is sometimes shipped in bulk, especially when sold by the car-load. Barrels are frequently used, when only a few are to be shipped to one address. Crates are often seen on the markets of large cities; these are about 2×4 by 4 or 5 In Florida, cabbage crates are made to hold a hundred pounds — smaller than the dimensions given above.

PREPARING FOR MARKET.

It often happens that much rain falls when the heads have become solid, causing them to burst. This may be prevented by running a plow with a long sweep on one side of the row to cut off most of the roots. The bursting is caused by an assimilation of too much moisture, and a consequent expansion of the heart, while the outer leaves cannot give sufficiently.

For shipping, nearly all the outer leaves are stripped off, leaving just enough to protect the head; the stalk is then cut off about even. The heads should be gathered dry, and kept so until they reach their destination. If somewhat wilted when received by the retail dealer, they may be placed in a cellar, or other moist place, when they will become crisp and fresh again.

Cabbage may be classed among the staple products, so people are not very notional about how it appears in the market. While it is an easy crop to grow, there are, on the other hand, a great many failures.

VARIETIES.

As there is practically no killing frost for this vegetable in our State it is found more profitable to raise the large kinds. Charleston Wakefield, Premium Flat Dutch and Louisville Drumhead are favorites in various portions of the State. For family use, when cabbage is wanted in as short time as possible, Jersey Wakefield or Early Winningstadt are desirable varieties.

CAULIFLOWER.

Up to the time of setting out the treatment of cauliflower is the same as that for cabbage.

SETTING OUT.

The rows are three feet apart, and the plants set about eighteen inches distant in the row. It requires more caution to set the plants out in time, if kept in the plant-bed too long. The plants should be set out as soon as they are large enough to handle easily. For this vegetable it is better to make three different sowings, about ten days apart, so as to be sure to have plants in good condition when weather is favorable for transplanting.

The vegetable must be treated more nearly like early cabbage than like the later. The soil needs to be richer and deeper than for cabbage. Plants must not be allowed to be checked in their growth at any time, as they are liable to run to seed, just as when they are allowed to remain in the plant-bed too long. It is a profitable crop for our home markets and can be matured until May, but after this maggots are liable to infest the heads. In the fall it may be planted to mature as early as the middle of December. It can be matured earlier than this, but the insect and fungus enemies are quite destructive in the fall and early winter.

When the crop is raised for shipping purposes the planting should be gauged so as to bring in matured heads by the middle of January, as the northern grown crop can be kept until about Christmas, and an early crop from north of us can be brought in by the middle of May, so we should try to have our crop mature from the middle of January to the first of May.

As mentioned before, the early cultivation and care is the same as for cabbage. When the heads have grown to about the size of a tea-cup the leaves are tied over them for bleaching, if it is to go to the fancy market. This is by no means a prevailing practice. However, this operation is a paying investment.

CUTTING.

After this vegetable has begun to head it requires a good deal of judgment to put it into the market properly. The field must be picked over repeatedly, and the matured heads removed, or they will spoil. If the weather is warm they are liable to spot, and this makes them unfit for market. To examine a head, part the leaves and see if it is beginning to crack; if so, remove it. In case the leaves have been tied over the head to bleach it, the leaves must be parted on the side to keep the sun off and light out. In cutting, a good strong knife with a blade about eight inches long is needed. Cut the stalk so as to leave about three circles of leaves. If the product is first-class it will pay to cut the stalk below the leaves and cart the crop to the packing house.

CRATING.

Trim off all but the inner circle of leaves and cut the stalk off and wrap in a thin paper. (The stalk should have been cut off smooth and even with the last circle of leaves.) In the fancy markets nearly as much pains is taken with this vegetable as with fancy fruits, and the growing of this class of cauliflower pays best. Before wrapping each head should be allowed to dry thoroughly. In the matter of package, the customers are not so particular, because the product is usually removed from it before it is sold by the retail dealers. The barrel or box should not contain more than two and one-half bushels, to avoid bruising the lower heads by the weight of the upper ones. For a distant market it is better to use a crate that will hold about as much as a tomato or an orange crate.

It has not been many years since it has been considered possible to grow this vegetable in our State, and the limit of its production has not been reached.

The seed is imported from Europe; only a small quantity being grown in this country. It is quite difficult to grow the seed in the gardening districts of the United States, as the heads have to be kept over winter and the seed grown the next summer. Fine heads cannot be kept from rotting, so half-matured specimens have to be chosen. This you see would degenerate the kind in a few generations.

Is not here a profitable employment for a small capital? Our crop can be matured so the seed can grow the same season. If a crop happened to be somewhat late it might be allowed to go to seed. With a decrease in the price of the seed there would be an increase in the quantity grown and an increase in consumption. As it is one of the most delicious vegetables there need be no fear of over-production.

VARIETIES.

Early Erfurt and Snowball are both good, and can be depended upon for a crop. There are other varieties coming into common use, but these two have the lead.

The price of the seed is one great drawback on cauliflower raising.

FERTILIZER FORMULA.

Available phosphoric acid	7 per cent.
Potash	8 per cent.
Nitrogen	5 per cent.

There is no choice as to the source of potash.

It will require about 2,000 pounds of the above formula to the acre.

CELERY.

The reports of success and the profits in celery growing in this State have been very flattering. Around New York City and Kalamazoo, Mich., it is one of the important crops.

SOIL.

Our State has enough excellent celery land to supply the market of the United States. In choosing a plot two points must be kept in mind. First, and the most important, the soil must be rich, not in humus alone, but in *phosphoric acid* and *potash* also. Second, the soil must be moist, but well drained. Much of our drained muck land has failed to produce celery because it was too dry. Again some have failed because the essential elements were not well balanced, and hence the soil was not really fertile. Again, some muck lands were too new, and caused the crop to "rust" and decay. Celery raising pays, because it takes more brains to raise it than many other crops do.

PREPARATION OF THE SOIL.

When celery raising is carried on for the market, as near New York and Kalamazoo, it is planted as a second crop. A crop of early vegetables is taken from the land, and then the celery planted. The land, having received a heavy treatment of manure before the early vegetables are planted, is not fertilized again, unless some thoroughly rotted compost can be applied. Fresh or undecomposed manure causes a rusting of the vegetable that unfits it for market. The old way of growing celery was to prepare the land well and deeply, and then make trenches six to eight inches deep, and set the plants in these trenches. This method is not followed now by the best celery growers.

Let us suppose that we have control of a field of drained muck land. The way to proceed will be first, to make the soil sweet and then plant the crop. Muck land will not be fit to plant the crop on for two or three years after it has been reclaimed. One of the best crops to prepare the muck land for vegetables is corn; this is quite exhaustive, but the roots penetrate the soil well, and corn is able to stand more sourness than many other crops. Rye and oats prepare the upper stratum well, but their roots do not penetrate so deeply as that of corn. When the soil has become perfectly homogenous, and the vegetable matter thoroughly incorporated, we may feel quite sure that it is in good condition for celery. It is advisable to test the field by planting out a short row of celery, the year before, on a typical portion; the growth of this will tell with a certainty whether the soil is in good condition. When the soil is in good condition plow the land deeply, harrow it thoroughly and remove all rubbish. Before plowing, all cornstalks, large weeds, sticks, and anything else that may interfere with cultivation, should be removed.

If it is a pine woods land that is to be put into condition the land must be cleared of all woody matter. The rows are then laid off and a double furrow plowed out deeply; as deep as possible with a two horse plow. Scatter in this furrow thoroughly decomposed compost of muck and stable manure, at the rate of about a two-horse load to a hundred feet of furrow. Mix the soil and compost thoroughly, gradually filling the furrow in doing so. It is true that celery will grow and produce good looking specimens without any vegetable matter being added, but it is of such quality as would not compete with the northern grown article.

SEED SOWING.

The seed is sown in July or August, preferable in a cold-frame or in a plant-bed, where the young plants can be watered easily and protected from the hot sun. If the plant-bed or cold-frame has been used before new fertilizer must be added before the seed are sown. If a new plant-bed has to be made follow the directions given for the preparation of these on a former page. Put a considerable emphasis on the use of plenty of fertilizer. Do not put the bed near trees to secure shade from them; they will exhaust the soil before the plants are ready to be transplanted.

When the bed is level and smooth use a six or eight inch board to mark off the rows. Lay the board down and mark along one side with a dibber, make the drill about half an inch deep and sow the seed in it, turn the board over and make a second drill and sow this, and so on until the bed is sown. The seed should be scattered thinly, about two to the inch. The plants should be thinned to about an inch apart, when the leaves begin to form. Care should be exercised to keep the weeds out by cultivating and weeding.

A celery bed should be cultivated at least every week and while the weeds are still in the seed-leaves they should be weeded out. If the plants tend to become spindly shear the tops off and the leaves will grow stocky. The outer leaves that were sheared off would have been lost anyway. Crowding the plants in the row makes them send out a strong down-growing root, that might be called a tap-root. If the plants are not crowded the roots spread out on the surface, and are constantly subject to slight droughts. In the case of a strong central root system the plant is nourished from the portion of the soil that is constantly moist. Another decided advantage is that the plants may be transplanted with less injury to the root system.

TRANSPLANTING.

Fine plants for transplanting are offered for sale every year at such a low price that it is difficult to see where the profit to the plant-grower comes from. However cheap the plants may be in the market, it is safer and preferable to grow your own plants and your own seeds. It however happens sometimes, through neglect or carelessness of the employees, that celery plants must be bought or the crop abandoned for that year.

If one has to buy plants from a distance the land must be entirely ready to receive the plants when they arrive. If it happens to be a dry spell the plants must be put into a bed where they can be shaded and water in abundance be supplied. A quantity of the plants can then be set out from time to time as one is able to take care of them. The setting out must not be delayed, for the plants will soon form roots from the reserve material within themselves, and if this has to be done the second time it will be a severe draft on the plant. If one has raised his own plants he may delay transplanting for weeks, awaiting a rain. If the land is in perfect readiness, as soon as the plants are large enough, which will be in October or November, they can be set out at the proper time.

The distance to plant the rows is three or four feet, according to the variety, putting the plants five or six inches apart in the row. Have the soil mellow and deep; stretch a line and use a dibber for planting. The surface of the land should be even and level. Cut off the tips of the roots; if they are quite long one-third of them can be cut off to advantage. Cut the leaves back about the same proportion. Place the plant into the hole made by the dibber, and press the ground about it firmly. Mr. T. Greiner says: "If you want to know if your work is done quite right, take a good hold of one of the leaves and pull. If the plant comes out of the ground, it was not set firmly enough; if the leaf breaks without loosening the plant, all is right." In our sandy loam we have to be a little more moderate, but the soil must be pressed firmly to the plant. In setting out put the bud even with the surface of the ground. The work of setting out can be facilitated by cutting the roots and leaves to the proper size before taking to the field. A strong boy may be employed to hand the plants out in good shape to the one doing the setting out.

After setting, the plants must be watered, unless the setting out is done immediately after a rain. After watering, as soon as the water has soaked into the ground, rake a thin layer of soil over the moist earth. If it is after a rain, work the ground lightly to give some loose soil on top. These directions, if followed out, will do much to conserve the moisture of the soil.

A few days before transplanting the plants should be hardened off to lessen the shock of transplanting. After having set the plants out they should be shaded to accustom them to the field gradually. The best device for this is an eight or ten-inch board placed obliquely over the row. The board is secured by stakes, which are driven on the south side of the row and slanting toward the north; by leaning a board against these the plants will stand in the shade during the hotter portion of the day, and be exposed to the sun in the evening and morning.

Celery receives the greater portion of its cultivation in the seed-bed. It is cultivated once or twice after setting out, and then the earth is gradually drawn up to the row, keeping the foliage on top of an A-shaped ridge. In the family garden this is made with a common hoe, but on the celery farms they have special machines for this purpose. These machines are drawn by a team, and hill both sides at once. This banking is for the purpose of blanching. This is simply to keep chlorophyll from forming in the stems, and to remove what has already formed.

Shutting out the light in many other ways is just as good as banking or hilling, if it keeps the light out as thoroughly. Another way of bleaching (or blanching) that is employed extensively is to use boards in the place of earth. Eight to twelve-inch boards are taken, according to the variety of celery to be bleached, and laid flat alongside of the row with one edge next to the plants; raise the outer edge of the boards up against the plants; now move the lower edge out a few inches, this will let the board stand against the row of celery; press the board down to shut out all light from the bottom, and the whole work of banking is done. In two or three weeks the celery will be bleached sufficiently for use. If there is danger of the boards falling they may be fastened by nailing a light strip from the one to the other. The upper edge of the boards should be pressed together firmly, but not hard enough to bruise the leaves. This method is fine for family use, but when celery is grown on a large scale it takes too much lumber and too much work in handling the lumber.

Among other methods of bleaching are those of putting tile around the plant, and of wrapping with thick paper or covering with a paper tube, but all of these have failed to meet the wants of celery gardeners.

There are, then, two ways of bleaching celery: First, by banking it with earth; second, by banking it with boards. The former is preferable when celery is grown on a large scale, and may be accomplished by hand, by a one-horse plow, or by a two-horse plow. The second method is preferable when celery is grown for home market or for family use, where refuse boards can be used, and only a small portion of the crop is wanted from time to time. Later in the season, or when the celery has attained its full growth, it takes nearly twice as long to bleach it. This should be borne in mind when it is prepared to meet the wants of a certain time.

The New Celery Culture.

The process is not quite true to name. It could be applied as well to the method of cultivating without using trenches. In short, the new celery culture is simply to cultivate celery with profit when the rows are planted about six inches apart and the plants six inches in the row. The main point in mind when this plan was suggested was to do away with the expense of bleaching. Three points must be kept in mind to succeed with this method. First, we must have a variety that is self-bleaching; that is, we must have a variety that makes enough shade to keep the stalks bleached from the time that it is large enough for the market. Second, the soil must be rich enough to support and mature six or eight times the usual crop. Third, there must be moisture enough present to fulfill the same conditions.

In preparing for this method we should remember how much fertilizer there was used on six or eight acres, and then put a like amount on one acre, and it will be necessary to have some way of supplying moisture. Some system of irrigation will be necessary.

This method, although it has many warm advocates, has not been tested sufficiently to be recommended without reservation. It has met with sufficient success to warrant thorough trials. The work up to the time of setting out is the same as for the old method, except in regard to the fertilizer. In marking out the land make checks from 7 x 7 to 10 x 10 inches, accordto the size of self-bleaching variety.

It must be borne in mind that the foliage must be dense enough to shut out the light as early as the stalks are large enough to market. As soon as the plants shade the ground completely the work is done; there is no hilling up except around the outside row. By planting successively from the earliest to the latest varieties we can have the crop come in during the entire marketing time, and bank only the out side row of the entire field.

The ordinary method furnishes about 20,000 plants to the acre; this new method nearly or quite 150,000. Mr. T. Greiner, quoted before, in his "Celery for Profit," makes a comparison of the two methods. He finds the expenses for raising and marketing one acre by the old method, is $260; that of the new process $920. These figures are about as low as they can be put; for our State we must add something for additional cost of fertilizer, and for transportation, but on the other hand our land is cheaper, and possibly the labor and plants are cheaper. Now for the profits; on the acre under ordinary cultivation it was $190; on the acre by the new culture it was $1,180. The estimate seems entirely fair; the celery is estimated at 30 cents a dozen bunches, and allows for a loss of about twenty-five per cent. of the plants set out.

Celery sheds have not been tested sufficiently to be recommended, but where this vegetable is raised on the new plan it will probably pay. The shed is constructed like a pineapple shed; posts are set 10x10 feet, and stand nine feet above the ground. The tops of the posts are connected by stringers running east and west. On these stringers are placed four inch battens about four inches apart. This shed cuts off one half of the sun's rays, and diffuses the remainder so they will not fall heavily on any one place. The battens running north and south distribute the sunlight more evenly than when they run the other way.

IRRIGATION.

In following the new celery culture it is necessary to resort to irrigation for the water supply. This supply may be distributed in one of two ways; either by open ditches at short intervals or by running tile near the surface.

When the water is distributed by open ditches, the ditches are cut three to four feet apart. In watering, these are allowed to flow full of water until the earth is thoroughly soaked, then the water is turned into another set, and thus continued until the whole area has been watered. These ditches are shallow, only a few inches deep. On a clayey soil the ditches are run nearly on the level, but on sandy loam there must be a considerable decline to have the water reach the further end, or the plants at the upper end alone will receive water.

Irrigating by the use of tile, or other more or less solid pipe laid into the soil is the better plan. This is especially advisable when the water supply is limited, as less is lost by soaking away and from evaporating. In this, as in the open ditches, we have a main supply, and running from this are the arms that do the feeding or furnishing to the crop.

MARKETING.

There is a rapidly growing demand for celery in our home market, and judging from the price that it brings to the retail dealers in our State, there must be a large profit somewhere, or somewhere a large waste. The many rich people who visit our State during the winter consume large quantities. These people want the very finest, and are willing to pay a good price for a fine article, while an inferior article will remain on the market, and usually would better remain in the field.

With the increased facilities for transportation we can put the article into the hands of our home consumers in two or three days less time than the New York or Kalamazoo market can, and this means a preference, even at an advanced price. Consumers want this vegetable crisp, fresh and free from "strings."

PREPARING FOR MARKET.

Celery is not grown so generally in our State that the local markets are supplied. There are only a few places that produce it at all, and these do so in quantity. It may seem like a small and slow business to train people up to like any vegetable, but a taste for this vegetable is easily cultivated. It has been only a few years since gardening for local sales has been profitable in many sections of our State, and in some it is not meeting with success even yet. The fault is as much that of the producers as of the buyers. There are a great many reasons why home markets should be cultivated rather than look to New York or other Northern markets, where our celery has to compete with the product from fertile land and cheap fertilizer. Jacksonville is not a good market for us, as we have to compete with the cheap ocean transportation from New York. We should rather look to some of our inland cities and towns. It is not uncommon to see an inferior grade of celery selling for ten and fifteen cents a bunch at the local markets and on inquiring it has been found that this has been shipped from a distance.

In the matter of preparation for market there seems to be very little choice in Florida. The main point is to get it on sale in a crisp form, and to have it sightly; both points are often overlooked, however. In the Northern markets there are two distinct ways for preparing this vegetable for market. The Kalamazoo shippers make a large bunch of twelve plants, the outer leaves are stripped off nicely, and the root cut very short and square across. These dozen plants are trimmed off nicely, are put into a square frame and tied and are then packed in flat crates or boxes and sent to market—either Western or in the Middle States. The Eastern or New England market calls for a little different kind of bunches. For this the plant must be trimmed to expose the heart to view. From three to five of such plants are then fastened together by driving a long nail through the roots, or they may be tied together. Most of the root is left on the plant, making the nailing possible. The size of the plants governs the number to be used in making a bunch. The bunches are then packed in long, narrow crates, so the whole can be inspected from the outside. The New Jersey, Maryland and Virginia markets usually accept celery packed tightly in boxes or barrels. For the local markets it is not necessary to use any particular form of package, yet where one intends to establish a business some regular form of package or crate should be adopted, as that makes a trade mark; the crate should be light and tasty. For long shipping a good crate can be made by making a solid bottom of half or three-fourths inch stuff; a rim around this about four inches high; this portion of the crate should be water-tight; put a one-inch square post in each corner, twelve inches high; nail a strip across each end, and several strips nailed to hold the plants from being removed. Crates of this kind, about two feet square, have been used, but the size may be varied to suit the occasion. In these crates the plants are shipped without trimming their roots.

To prepare celery for the market two tubs of water are taken to the field, and as soon as the plants are dug they are plunged into one tub, washed off well, and then into the second to rinse, after all the green and partially dried leaves have been picked off. If they are intended for a near market the roots are cut to suit the trade. For long distance shipping the roots are left on and the crate sprinkled after it has been packed.

VARIETIES.

Giant Paschal is said to be the best for our State. Several other varieties have been grown successfully, but not generally enough to warrant definite statements. Probably one will find that most of the good varieties for other States will do well here.

FERTILIZER FORMULA.

Available phosphoric acid	7 per cent.
Potash	7 per cent.
Nitrogen	5 per cent.

On muck lands or drained bottoms use less nitrogen and more potash than given in this formula. Fourteen hundred to 2,500 pounds to the acre will be necessary; for the new celery culture about six times this quantity is needed.

CUCUMBER.

This has become one of the leading vegetables for the South. It stands shipping to distant markets remarkably well. In that portion of the South where there are frosts the seedlings should be started in a cold-frame or in a hot-bed. This seems like very remarkable advice to those who have tried to transplant them, but it is easy enough when you know how. For every acre that is to be planted procure twelve hundred two-inch, paper flower pots; the same number of four-inch, and, if very early cukes are wanted, the same number of six-inch. Use only the best seed, and plant them four in each pot. These pots should be filled to within a half inch of the top with good potting soil; it is planted six weeks earlier than the last frost usually occurs, if it is intended to use only the two smaller sized pots; but about nine weeks if the three sizes are to be used. The cost of the pots in the former case will be less than nine dollars; in the later about twenty-five dollars. There is no doubt but that one could obtain a large discount on these pots, if a large quantity were to be bought at one time. If these pots are not sunk into the sand they will stand for two crops. During their growth the plants should be examined frequently to see that they do not become pot-bound. They should be shifted to a larger pot as soon as the soil is permeated by the roots. This may be tested by removing the soil from one of the pots which may be done easily as follows: Hold a pot upside down, press on the bottom, this will loosen the soil, the condition of the roots can now be examined without difficulty. As soon as the roots have taken up most of the space in the pot shift the plant to a larger one.

The plants should not be transferred to the field until two weeks after danger from frost; if the spring is cold and backward it is better to keep the plants under the protecting cloth. This method seems to be rather expensive, but it avoids all danger from frosts, and if the six-inch pots are used the plants will be too far advanced to be hurt by the cucumber aphis. Much useless working of land is also avoided. On the other hand it requires skill and experience to prepare the potting soil properly, also care in handling the plant bed. The amount of work will be found to be less than when they are planted directly in the field. The amount of seed is reduced to a minimum, and its efficiency to a maximum.

PREPARATION OF THE FIELD.

The light sandy soil of Florida is well adapted to this vegetable. It thrives well in all parts of the State. Any kind of decayed vegetable matter will make good manure. Lay the field off in checks six by six feet, in these spread the fertilizer in a circle about three feet in diameter. Work it well into the soil and plant the hill in the centre. If one desires to plant the cukes in the field the seed is dropped in the centre of the fertilized spot; in this case drop about a dozen seed in a hill a foot across; the insects and other enemies will destroy so many that you will not have to thin out many hills. After the vines are about six inches long the hills should be thinned to three or four plants. Some hills will be missing, these can often be supplied by taking up a portion of some other on the hoe and transferring it to the place that has failed.

CULTIVATING.

If there is no other crop on the same land no attention need be given to the portion in the middle of the rows so long as there are no weeds going to seed. As the vines grow out from the hills as a centre more and more of the middle is added, until the vines have finally taken the whole field. If any vine or vines toke a notion to run, the end should be cut off; this will make them branch. It is well to see that the hills claim all the ground as they grow out; if they fail to do so, cut the tips of the runners and new ends will form. It is not a well to shift a vine—that is, take it up and shift it from one place to another. At various points roots come out, and these help the tap-root to support the plant, and any interference with these works a damage to the plant as a whole.

PICKING AND PACKING.

As soon as the blossom-end of the young cuke has filled out plump it is mature, and should be picked for shipping or for market. Care must be taken to remove any that have grown too large, as the vine sets only a few more after a cucumber has been allowed to ripen. If they begin to show the want of fertilizer, some quickly available form can be given them, and the bearing season prolonged almost indefinitely. The size that is wanted for pickles varies with the market. Some require large and other markets small ones. In no case should a cull be allowed to remain on the vine; they often pay for their picking in the local market, or they can be given to hands and neighbors, but they are not worth the shipping room.

The marketing is done in a crate, of the same size as the pea and tomato crate. Cukes are picked dry and taken to the packing-house; here they are sorted and crated. They are laid evenly and tightly in the crate, and finally pressed down and nailed. The packing must be so tight that the product will not shake on the way. A field has to be picked over three times a week.

The amount that an acre will produce is almost incredible. While two hundred to three hundred crates may be considered a fair crop, we have reports of six hundred, eight hundred, and even nine hundred crates to the acre.

VARIETIES.

There are many varieties that are commendable for forcing, but for field crops none have yet exceeded the Improved White Spine in popularity.

FERTILIZER FORMULA.

Available phosphoric acid	7 per cent.
Potash	8 per cent.
Nitrogen	5 per cent.

Fifteen hundred to 2,500 pounds per acre will be required on most land. If the land is rich in organic matter, use less or none of the nitrogen, according to the amount present. A tablespoonful of nitrate of soda sprinkled about the hill as soon as the plants are up will hurry them along out of danger from insects. Too much nitrogeneous matter makes poor shippers and over-grown sizes.

EGGPLANT.

This vegetable is rapidly becoming a money crop in Florida. Although it can be grown in the Northern gardens it is not profitable and does not do well. It requires long-continued heat to develop the fruit well.

The greatest obstacle in the way of success has been that the gardeners have failed to supply the necessary fertility to the soil. One of the prominent eggplant growers of the State began by raising ten acres, and did not make anything on the crop; then he reduced the acreage to five, and gave the same amount of fertilizer that he had put on the ten acres before; again he cut down the acreage, this time to two and a half acres, but the amount of fertilizer was kept at the original figure, and the attention increased. The two and one-half acres have as much fruit as, and of a better quality and finer shape than, the five acres. At this point the gardener did not cut down the area, as he thought he had reached the maximum of high culture.

For early fruit plant the seed in a hot-bed about the first of December. When the plants have grown to be about an inch prick them out into two-inch paper pots; keep them in a hot-bed or a cold-frame, and guard closely to protect from cold. During the cold, windy days the protecting cloth should be raised, but when there is a chance to let in some warm sunshine it should be done. If the weather is rather cold the plants will grow very slowly, but if there is some bottom heat the roots will make a good growth. As the roots begin to show that the room in the pots has been occupied the plants must be shifted to larger ones. If six-inch pots are provided the plants may be grown to six or eight inches high before setting in the field. They should not be set out until all danger from frosts, and from having a cold spell, is passed.

There is very little danger in getting too much fertilizer on the land, the difficulty is in not having it incorporated thoroughly enough. Two tons to the acre of the ordinary vegetable fertilizer will be found to be only a moderate application.

KIND OF SOIL.

A sandy loam will be found excellent soil; this should be well drained and have a moist subsoil. Land that has been drained, if all other conditions are proper, will make an excellent field.

This plant is a deep feeder, so that the land should be plowed as deeply as possible. A new field should not be taken, while one might succeed, the chances are not so good as on an old and well-tried piece of land. Be sure that all rubbish and matter that could interfere with cultivation has been removed.

Fertilize the field broadcast; there is little or no danger of the plants failing to get the food if it is in the soil. The best way is to apply the fertilizer just before plowing the field, and then apply a smaller amount where the plants are to stand; work the fertilizer in well a week or two before setting out.

Lay the land off into rows four feet apart, and set the plants three or four feet apart in the row. At convenient distances a row may be skipped to make a road to gather the crop.

After the crop has been planted there is little or no use for a hoe; the plow can and ought to do the work. No weeds should be allowed to show more than the seed leaves, and the ground should be kept mellow enough to let a person sink nearly to the ankles in dry times. When the fertilizer has been applied properly the roots will seek the deeper soil, and the ordinary horse cultivator will not reach them at all. Eggplant raising pays best under high cultivation.

By replenishing the fertilizer, plants may be kept in bearing until frost kills them in the fall, but it will be found more profitble to renew the field, if a summer or fall crop is desired.

MARKETING.

The fruit is mature for shipping when it is half grown or before the seed begins to swell. This can be determined best by trying several specimens. The change of color is also somewhat of a guide; it usually turns from a bright purple to a dull color. Eggplant is usually marketed in barrels, and is quoted in this way. This is not a good way, however, as it gives more opportunities for petty fraud. Some form of crate which is easily handled and that will exhibit the vegetable is very desirable. The crop is too bulky for the ordinary vegetable crate, and by the time the crop has reached the proportions of supplying the demand more barrels will be required than can be supplied.

A barrel crate, exhibiting well packed and nicely colored fruit, sells more readily than the same amount in a barrel.

VARIETIES.

Several varieties have been fruited on the Experiment Station; the earliest was Improved New York Spineless; this is a good variety for table use, but is not prolific enough for commercial purposes. Black Pekin is a later variety, but produces a large crop and finer berries. Seed bought under this name proved to be the best market variety in the test.

Fertilizer Formula.

Available phosphoric acid	6 per cent.
Potash	7 per cent.
Nitrogen	4 per cent.

Three Thousand to 4,000 pounds to the acre applied to the hill and well incorporated. Cotton-seed meal or other vegetable matter should be used to apply the nitrogen.

LETTUCE.

This vegetable is grown with profit as a market crop in some sections of our State. As far north as Gainesville it may be grown in the open field during the entire winter. It will stand a temperature of 20° F. without material damage. Some varieties are more sensitive to cold than others.

Seed-Bed.

The loam in the seed-bed should be rather coarse-grained, with a mixture of humus; much very fine sand in the soil makes it unfit for either seed-bed or field. Seed is sown in drills two or three inches apart, or it may be scattered broadcast and covered lightly. It should be protected from the sun, and not allowed to be dried out by winds. Plenty of moisture is necessary, but the drainage must be good. As soon as the seed-leaves are well developed the largest plants should be picked out with some small tool, and transplanted to a plant bed. Here the rows may be four inches a part, and the plants an inch in the row. In selecting the seedlings to be transferred only the largest are chosen, the inferior ones should be destroyed. The plant-bed being made up of strong soil will force the plants along rapidly. In about three weeks the plants will be ready for a transfer, this time they may be set in a cold-frame or in the field. For setting in the field only the best should be chosen, thus selecting the best of the best, and getting a lot of plants that are quite uniform.

PREPARING THE FIELD.

The soil should be made up of a friable loam; there should be an abundance of humus present but a very small amount of silt or very fine sand. While the soil must be rich it need not be deep, and the preparation may be shallow; deep plowing is useless. All rubbish must be removed. Lay off the rows eighteen inches or two feet apart, and make checks from six to ten inches, according to the variety. Having a handful of selected plants drop one at every check; then with a dibber or forefinger force the root into the ground at the check. Press the soil tightly about the plant and the work is done. The plowing should be done with a horse and finished by hand if necessary; the work should be shallow but all the weeds kept down.

VARIETIES.

One of the best varieties is Grand Rapids. Black seeded Simpson and Blond Blockhead each make excellent heads, and in their prime are finer than the first named, but their time is much shorter than that of the former, and they do not mature so uniformly.

FERTILIZER.

Available phosphoric acid.	9 per cent.
Potash.	12 per cent.
Nitrogen.	5 per cent.

If the land contains an abundance of nitrogenous matter the per cent of nitrogen may be decreased. Use 2000 to 3000 pounds per acre. In a cold-frame or hot-bed, or in composting for these, use a pound for every two lineal feet (12 square feet) of frame.

MARKETING.

The tastes of different markets is not fixed; any good shipment will meet with a fair sale, however. Some prefer loose heads while others choose solid ones. It may be shipped in barrels or open crates; in either case the packing must be firm, but the leaves must not be crushed. If the crop is not of a golden yellow and tender, it can be made so by covering it with something that will keep out the light. For such purpose boards or heavy cloth may be employed. Lettuce that has matured a little too much may be treated this way and be made marketable.

ONION.

Of all the crops that we have there is none that requires more attention in the manipulation of the land previous to planting than this one does. The only reason why this crop is not more largely raised in Florida for market is that so many people do not go into vegetable-growing with a view of sticking to it. In the onion-growing districts land is said to improve with each crop that is removed from it. Land that has been cropped for twenty years is raising better crops now than the neighboring land that is just being cleared for that purpose.

Soil.

A sandy loam, with clay subsoil, will give excellent returns, provided there is an abundance of humus or other nitrogenous matter present. Most of our land is subject to too great a variation in the moisture it contains. The roots of onions do not enter the soil deeply, so they are easily affected by changes in the upper stratum.

Preparing the Land.

In selecting a plot of land, be sure to take one that does not become soggy in wet weather nor dry during a drouth. If the right kind of land is not at hand, some should be bought that is all right—not rented, unless one can have the option of buying it at a fair price. One should not go into onion-raising as a temporary employment, unless he be an onion grower from some other section—and those need no advice. Where it is possible to have an artesian well it will be found profitable to irrigate the land. The land should be well drained. Put the under-drains close together, so as to remove the surplus water quickly.

The land should be shallow but thoroughly plowed, leaving no particle unturned. Remove all roots or sticks, or other debris, before plowing and again after plowing, then harrow thoroughly, removing every particle in the form of sticks or straw; even the roots of last year's grass should be removed. After the land has been thus thoroughly prepared, it should be allowed to remain a month or so before planting; during this time it should be stirred again and fertilized.

SEED.

The Bermuda has been recommended as being the best variety for a crop in this State. There seems to be a good deal of difficulty in obtaining the genuine seed. This is a very important point in the success of onion-growing. There is probably no other crop where so much depends on obtaining a good strain of seed. It is not profitable to use old seed when new can be obtained.

SEED-BED.

The seed should be sown in seed-beds, or cold-frames, prepared with special care. These should be prepared a month or so beforehand, and should be worked over frequently to have the fertilizer incorporated into the soil. These seed-beds must be constructed so the moisture in them can be controlled.

If the seed-bed is free from weed-seed, as it should be, the rows may be made about three inches apart and the seed sown thick enough to raise about three thousand plants to one linear foot (six square feet) of standard cold-frame. This will give 500 to 750 plants to a row six feet long. There is considerable variation in the number of plants that can be produced from an ounce of seed. Good gardeners are able to produce 5,000, but we will put the figure at 4,000. There are so many elements that enter the question that the number cannot be exact. When the seed-bed is cared for properly it will give plants large enough to be set out in six weeks.

TIME TO SOW.

As in the case of potatoes, one should watch the Northern markets and crops. If onions are selling for a very small price in the fall it is clearly not wise to put a large crop for early spring, but shipping time should be delayed a month or two. A good product never fails to bring a fair return; it is quite unusual to sell any portion of the crop in our State for less than a dollar a bushel.

The seed may be sown any time from the first of September to the first of January. The last date brings it into competition with the crops raised in the States just north of us, but the price is not usually low enough to make the crop an expense. October is a favorite date, and one that brings the crop into market after the stored crop has been consumed. Immediately after the seed has been sown in the cold-frame the preparation of the field should be commenced.

FERTILIZING.

Good compost or well-rotted barnyard manure will be found excellent, and guano still better. Whatever kind be used be sure that it contains no weed seed. If both home made and commercial fertilizer are to be used, plow the former in, and after the land has been well worked down use the latter broad cast, and mix it with the soil by using a cut-away harrow. In the matter of using fertilizer Mr. Gaitskill's advice to the Florida State Horticultural Society should be followed. When discussing the amount of fertilizer to use on vegetables he said: "Put on all you think the land can stand, then put on as much more, and you will have about half enough."

SETTING OUT.

The most expensive operation in the growing of onions in this way is the setting out. This will be found to cost about $40 an acre. Boys and girls will set out 2000 to 3000 a day; a good man can set 4000 to 5000, and it takes about 160,000 plants to an acre it will be seen that it is no small job. It is claimed by persons that have set out several acres that they can do so at the cost of $20 per acre. Persons that are not familiar with onion growing will consider this an almost insurmountable obstacle, but when we remember that it does away with the early weeding and hoeing, the expense will not be so heavy as at first supposed. Twenty dollars is not sufficient to bring an acre of onions to four weeks old by the old method, and have the field free from weeds.

After the seedlings have grown large enough to be handled easily they should be transplanted. Mark the rows off about twelve inches apart if they are to be worked by hand; if by horse-power the rows must be from twenty to twenty-four inches apart. A simple rake-like contrivance that has teeth at proper intervals will serve the purpose of a marker. If the marker is wide enough to mark out six or eight rows at once it will be found steadier than a small one. All that is necessary is to make a mark for a guide; the lines or marks need not be deep nor broad. A revolving marker may be made by fastening a thin rope around a wooden roller and inserting pegs at proper intervals on the circumference, it will lay off distances and be a good guide in planting. If the pegs have been put so they will make a dot every twelve inches in the row, all that is necessary is to set a plant in each dot, and then put three between. These dots are especially desirable if one has boys and girls at work.

For setting the plants a small, flat dibber is used; a home-made one will serve the purpose as well as any. A piece of seasoned hard wood, one inch square and six long, should be shaved down to a flat point and a handle fixed across the top. Such a tool can be made easily and quickly, or one may have a steel one made by a blacksmith; these will be found better, but where a good many hands are being worked it requires some forethought and some expense.

To set the plant insert the dibber on the line and press it from you, set the plant with the other hand, remove the dibber and set it in the ground beyond, and press the dirt firmly to the plant. This operation insures that the soil will be pressed firmly about the roots of the plants. The plants must be set perpendicularly, or an ill-shaped onion will result. When one has many hands at work they should be divided into gangs and placed under a careful foreman, who shall see that the work is done properly and keep the planters supplied with sets.

The seedlings may be removed from the bed by passing a trowel under the row and lifting a lot of them at once; then separate from the soil, and trim off the long roots and leaves. The leaves are in the way of later cultivation and the roots bother in planting.

CULTIVATION.

"Tillage is manure," is an old and true saying, but in cultivating onions we must be careful that it is done properly. There are just two points to be kept in mind when cultivating onions; the first is to keep the weeds down, and the second is to conserve the moisture in the soil. The former of these is well understood by all gardeners and needs but to be mentioned; the second, however, is usually overlooked; many people recognize the value of working land during dry times, but do not know why it has the desired effect on the crop. At least an inch of loose soil should be kept on the ground as a mulch during dry times.

For hand cultivation the double wheel-hoe is undoubtedly the best machine now on the market. Whatever tool is used it should not penetrate the ground more than an inch and in no case touch the bulb of the plant.

If the field is to be cultivated by horse-power it will require a plow made especially for that purpose; there is no difficulty in training a horse or mule to do the work well, and a great deal of hard work can be avoided by using one. In the onion-growing sections the land is too costly to permit the use of a horse, so the wheel-hoes are used exclusively.

The workers in the field carry a bag with them to receive any purslane or other plant that may have been missed or allowed to grow to flowering size. All large weeds are carried to the edge of the field and thrown in heaps to rot. There are very few fields that are free enough of weed seed to grow a crop without some hand weeding; this should be done with a knife, *i. e.*, large weeds should not be pulled when growing in the row. For this purpose there are knives made, which may be obtained from most supply stores, but an old case-knife may be bent into good shape, without costing as much. The point is turned up to lessen the danger of hacking into the plant as the hand works along.

The ordinary garden hoes do not work well in the onion fields; a worn out one that has been cut down to one half its width, so as to leave the corners obtuse, will work pretty well. All tools should be kept as sharp as the steel will permit; a dull hoe will soon use up more time than would buy a new one.

THE OLD PLAN.

The primitive method of raising onions is to sow the seed in the field where the crop is to grow. This method is still followed in many onion-growing sections. Prepare the land in the same way as you would for setting out. Sowing is best done by a seed drill. Set the drill so it will sow from twelve to thirty-six seed to the linear foot, according to the variety and the germinating quality of the seed. Make the rows from fifteen to twenty inches apart. During dry weather the seed is very slow to germinate; I have known it to lie in the ground for six weeks without any perceptible change. To anticipate such a condition, one should mix radish or rape seed with the onion seed in such proportion that one of these seeds will be dropped about every foot. Radish and rape seeds spring up very quickly, and are easily seen. This will mark the rows so cultivation may be carried on before the onions are up. If a beating rain occurs before the onions are up, or as they are just appearing, it is liable to smother the tender seedlings, but by cultivating after a heavy rain the water draws off rapidly and does less damage. (Of course this cannot be practiced on clay soil.) Cultivating during dry weather keeps the soil moist.

It is only in an exceptional year that onions can be grown with profit on weedy land. Keep down all weeds in the middles by the use of a hoe or wheel-hoe. The weeding, or removing of weeds from the row, is, at best, a slow and expensive task; often the workmen have to get down on their knees and elbows. Only competent laborers should be employed; incompetent ones are liable to disturb the seedlings, or simply pull the tops off of the weeds, either of which might go without detection for a week.

CURING THE CROP.

When a majority of the tops fall it is a sign of their being ripe. The crop should be pulled and allowed to dry; this will take about a week of dry weather. If a rain occurs it will be necessary to turn the bulbs, which can be done with a garden rake with dull teeth. Rain is liable to bleach the crop and so damage the sale. This is best prevented by taking the crop to a curing shed, which simply needs a roof to keep the rain off, and possibly some movable sides for rain-breaks, to prevent a driving rain from wetting the crop.

The tops should not be removed until they are dry, and break easily and can be stripped off without difficulty. It is usually better to push our crop forward as early as possible. The maturing may be hastened somewhat by knocking the tops over. As soon as the roots loosen their hold on the ground they may be pulled, but there is some danger of their making a second start if the season is rainy. In such a case they must be drawn out and cured quickly. In a dry storing room onions may be kept for a long time to wait for a good market.

CRATING.

It is not necessary to use fine material to make onion-crates; the poorer quality left from sorting tomato crates will be found to bring as good a price as the finer ones. In packing, the crates should be well filled to prevent the product from being bruised, as bruised ones rot down very quickly. All culls should be removed from the field, and composted, to prevent them from drawing insects and growing fungi.

FERTILIZER.

It has been mentioned before that stable manure is not popular as an onion fertilizer; principally because it contains so much weed-seed. A soil that contains an abundance of humus is desirable, consequently all weeds and manures should be composted and used in this way.

If the land is already rich in nitrogen, as, for instance, muck land, it will not be necessary to add much of this element in commercial fertilizer. A well balanced fertilizer for ordinary gardening land should contain.

Phosphoric acid, available	6 per cent.
Potash	7 per cent.
Nitrogen	4 per cent.

Use a ton of this on land that is considered fertile enough for an ordinary crop; two tons may be applied on land that has been cropped several years.

If the plants do not start off readily, and the conditions of temperature and moisture are all right, a light dressing of nitrate of soda will be found valuable. Mr. T. Greiner advises the use of seventy five pounds of nitrate of soda to the acre; sown on broadcast as soon as the field has been set out. And a repetition of this about every ten days, until five applications have been given. If this is done when the plants are free from dew and rain there will be no difficulty from scalding the foliage. It should not be carried on too long, as it will keep the onions growing after they should have ripened; this same difficulty will be experienced if one uses a fertilizer containing an unusual amount of nitrogen, or if one should use a complete fertilizer on muck land.

Raising Onions from Sets.

The earliest onions to mature in the north are those raised from sets. The operation differs from the above only in that the sets are in a dormant state and are handled more easily. The general directions will remain the same.

ENGLISH PEA.

This vegetable is very generally cultivated in the South for early market. It is quite a staple crop, and as it requires very little skill it is a favorite with many who are not able to raise other vegetables. The land should be well prepared though not deeply, about the last of October or in November; the fertilizer scattered along the row and mixed with the soil. This crop will stand a light frost and grow even in quite cold weather.

For shipping purposes the dwarf varieties should be chosen. The McNeil pea has been very largely grown in Columbia County. The American Wonder and Blue Beauty do exceedingly well. The large number of varieties offered for sale often leads to confusion, but the three named above may be regarded as trustworthy.

A light warm soil is very desirable for winter crops. If one uses a seed drill a row should be made up of three or four drills about one inch apart. This will give them a chance to hold to one another and thus form supports. The ordinary practice is to make a row about six inches wide by scattering the seed along a furrow and covering about an inch deep. Peas sown later than the first of January are liable to come into competition with those grown farther north.

FERTILIZER FORMULA.

Available phosphoric acid	7 per cent.
Potash	7 per cent.
Nitrogen	3 per cent.

For this crop it will be found desirable to use mineral fertilizer rather than compost. If nitrate of soda is used it will require two applications, one at the time of sowing, and the second just as the first flower buds begin to show. Cotton seed meal can be used as a source of nitrogen before planting, as a portion of a complete fertilizer. Nitrate of soda will cause the vines to make a vigorous growth, so should not be applied when a frost is looked for. Use 1,200 to 2,000 pounds to the acre.

Cultivation is needed more to get air into the soil than to keep the weeds down. During cultivation the soil should be gradually worked up to the row so as to leave them hilled up at the last plowing. The distance between the rows should be about twenty inches for strong soil.

MARKETING.

An ordinary vegetable crate without a partition will be found the proper thing to ship in. Picking is a tedious job, but it is not difficult to obtain an abundance of help. As soon as the pods are well filled the hands may be sent into the field. The earliest shipments are usually the most profitable. There is rarely any difficulty in the way of diseases in the field or rotting on the way. Sorting is also not necessary, and the peas may be put into crates immediately.

SEED.

Most of our seed is imported from England on account of so much of the home grown seed being infested with the pea weevil. While this insect usually leaves the germ unhurt, the amount of nourishment taken out of the seed weakens the seedling. This insect is not severe in our State, hence much seed could be supplied to the market, especially in those years when the market for green peas is overstocked.

TOMATOES.

Twenty years ago it was considered by many people living in this State that this crop could not be grown successfully. Later experience has demonstrated that not only can the crop be grown, but that it is profitable for whole communities to make this their money crop. To those who understand how to manipulate this plant it is as certain to be a paying crop as any other.

As has been stated before, it will not pay any one to go into this industry as a temporary employment. There is too much downright hard experience in tomato raising to warrant the undertaking of it for a single crop or so. Your neighbor cannot superinteud your work, nor can he give you sufficient instructions to enable you to carry it on successfully. The operations from the buying of the seed to receiving the cash for returns are so many and varied that the beginner is very liable to make a mistake somewhere. The prospective gardener should not consider it insurmountable, but he would better begin moderately and work up gradually.

PROCURING SEED.

It is not out of place to emphasize the advice given before, that one should procure nothing short of the very best article in buying seed. If a new variety has been offered to the trade, go slow before discarding the old and well-tried one. Buy of no one but seedsmen that you know to be entirely reliable in their dealings. The seedsman has his reputation at stake, but you have your capital. Then there is some choice even among the seedmen who belong to the first class; buy tomato seed from the firm that makes this their special work, and the same with other seed.

SEED SOWING.

In South Florida it is not necessary to have any other protection on the seed-bed than shade; it is well to be able to supply this, however. The seed-bed should be made as carefully in the tomato section as the hot bed or the cold-frame is made in Northern Florida. Some tomato growers have planted the seed in the field; *i. e.*, it was not sown in beds. From the amount of trouble that this gives rise to there can be no doubt but that the method of planting in the seed-bed is better and cheaper in the end. At the time of the year when the seed must be planted the insects and the weeds are exceedingly destructive. The ease and efficiency with which one can take care of the plants in a plant-bed will more than compensate for the time required in setting them out.

SEED-BED.

The plot of ground after being prepared for the seed should be rich in nitrogenous matter; either compost or commercial fertilizer will be found to give good results; cotton-seed meal has given excellent results. Whatever substance is used it should be worked in thoroughly, and the bed be allowed to stand ten days or two weeks before the seed is sown. During this time the intended seed-bed should be kept thoroughly wet so the soil can take up the fertilizer. If the plants are to be shifted, a bed five by six feet will hold enough plants for an acre, but if they are to be planted in the field without shifting it will take a bed six by fifty feet. In the latter case each plant is allowed sixteen square inches. If the rows are made eight inches apart, and the plants thinned to two inches in the rows, it will give the required space. In making a plant-bed an abundance of fertilizer should be used, and water liberally supplied. A half a sack of cotton-seed meal to a space six by fifty feet will not be too much, provided it is worked into the soil thoroughly, and decomposed before the seed is sown. If the matter of decomposition is not looked after cautiously there is great danger of damping off. If leaf-mold can be obtained from a neighboring hammock it will pay to haul this and make the bed of it, adding commercial fertilizer, however. The fresh leaf-mold is not good, but it will be found excellent after the sourness has been taken out of it by raising a crop of radishes or some other short-lived plant on it. Use four cart loads of well decomposed leaf-mold to a hundred square feet of bed surface.

The leaf-mold is also used for the seed-bed. When you are sure that the fertilizer is mixed evenly with the soil, and is decomposed, the seed may be sown in drills. If the plants are to be shifted, and this is certainly advisable, make the drills three or four inches apart, and sow the seed at the rate of five to an inch. As soon as the leaves (not seed leaves) appear the plants may be pricked out and planted in beds. Make the rows four inches apart and set the seedlings an inch apart in the row. When they have reached a height of four inches they should be shifted to another bed. This time the rows may be made eight inches apart, and the plants set two inches in the row. If possible the plants should be kept in this bed until the danger from grasshoppers in the field is past. They may be kept in this bed until they are ten inches high; there is nothing gained by setting out small plants. The object of shifting the plants so many times is to harden and give them a strong fibrous root-system. A plant grown without shifting is usually wanting in the first particular and always in the second.

HARDENING OFF.

One should not be in a hurry to plant out tomatoes. The field should be well prepared, and the ground well warmed up by the spring sun in northern sections of the State. Much time may be thrown away by being in a hurry to set the plants out even in South Florida. The shock attending the setting out of a crop is not so much because of root mutillation, but because of being placed in disagreeable surroundings. When the plants have been grown in an open bed the atmospheric conditions are usually all right; in such a case the mechanical condition of the soil is all that is necessary to be considered. For several days before setting out water should be withheld; if the plants are quite large and the time can be spared, it will be found better to harden the plants for a week or ten days. Just before removing from the plant-bed wet the soil down thoroughly. Much more soil will adhere to the plant, and it will be found comparatively easy to start a field in this way.

PREPARING THE FIELD.

The tomato plant is a comparatively deep feeder and so wants as much soil as can be supplied. New land is not the best to use for this crop; there is much danger from fungoid disdiseases on such land. So long as the soil is kept free from the enemies of the tomato, the plant will not grow tired of a location; crops may be raised a great many consecutive years by the use of commercial fertilizer, without any diminution in yield. Some tomato growers are able to raise better crops on old land than on new.

The soil should be light, warm and sandy. There is not much choice in regard to the slope, except for northern Florida, where the southern slope will be found preferable. A good water protection should be sought. This cannot always be found, but a wind break can be grown and kept by every one. While this will not protect a field against frost, it will break the force of many cold winds which do much more damage than we think. An unprotected location should not be selected; while the best of land and locations may be had for the same price it is folly to work against odds. In 1892 a case was observed where a narrow strip of oaks was of more value than a water protection. In this case the field was lying to the southeast of a small oak hammock, it was really the southeast slope of a cleared hammock, a portion of which had been left to the north and west. The frost killed out all the tomatoes but about five acres highest and nearest to the remaining portion of the hammock. Other fields of the same altitudes within sight that were not protected, and all fields not as high even though near bodies of water, were frozen.

FERTILIZERS.

There are fertilizers on the market that have been put up especially for tomatoes, and usually go under that name, Tomato Special. The ingredients of these "tomato specials" are not always known, but should contain about the following:

FERTILIZER FORMULA.

Available phosphoric acid.	7 per cent.
Potash	6 per cent.
Nitrogen	4 per cent.

Kainit is a good source of potash, and at the same time the by-products in it act as fungicides, and give very beneficial results on blight. Nitrogen should be obtained from nitrate of soda and cotton-seed meal; the former, making up about one per cent. will be available immediately, and the latter gradually. Use 2000 to 3000 pounds to the acre, and apply at one time and work in deeply. If the land is thirsty the fertilizer should be applied at three different times, using about one-fourth of it the first time or just before setting the plants, and one-third when the plants begin to bloom; the remainder to be applied a week before the earliest picking. The best tomato land will give the most profitable returns for the amount of fertilizer used by applying it all at one time. If hill fertilization is practiced the space that the fertilizer is applied to should be about three feet in diameter.

SETTING OUT.

A great many different schemes have been invented to do away with the "peg-and-bucket" method of transplanting, but cautious tomato growers still adhere to the primitive method: The nearest approach to this method is a machine drawn by a team, and the planting performed by two boys.* A certain quantity of water is left at the place where the plant is to be set; after the plant has been set the machine covers the roots and also the moistened places, and at the same time presses the soil firmly into place.

When they are being removed from the bed a sharp spade should be set down deeply between the rows, and then again in the row; this will secure a square of the plant-bed soil. Put the plant in the setting out tray, and move to the field. This tray may be made from a shallow soap-box with one end knocked out, and a hoop handle nailed to it or auger holes put into the sides. When the plants have been cut properly such a tray, 24x17x4 inches, will hold at least twenty-five, and sometimes as high as seventy-five plants. A plant can be slipped from the open end to the place where it is to be set, and so avoid moving much of the soil from its roots. Some time can be saved by one person passing along the row and dropping the plants while another follows to set them.

Some tomato growers have used a method that seems to be quite unique, but judging from the number who have abandoned it one would judge that it does not meet with great success. A furrow is run out and the plants dropped in checks; a second furrow is thrown onto the roots; on the return the plow is run down the other side, so as to set the plants upright. This method is mentioned here to advise the readers on that point. Those who have not tried this method, and wish to adopt it, should consider it carefully and then use it only on a portion of the crop. There are conditions and localities where it might be used to advantage.

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*Illustrated on page 15 of Bulletin 21, Fla Ag'rl Exp. Station.

Most of our land cannot support plants well when set two by two feet. A very common distance is four by four feet. It is well to lay the field off with a marker. This may be made by using two-inch planks about eight inches wide; cut them into four-foot lengths, fasten four of these in the fashion of a four-runnered sleigh, making the distance between the runners just what you wish that between the rows to be. After the field has been laid off one way, it may be crossed, and the plants set out in the checks. If it is desirable to have the plants closer in the row the distance between the runners may be changed. A drag, which may be changed from one side to the other, can be attached to mark a guide-line for the next set of marks. It will usually require a team to drag one of these markers. A wagon-tongue or pole is usually attached to it to make the marker manageable.

It is well worth the while to have the rows as straight as they can be made, and to make the cross rows equally straight. It is possible to put the field into such a condition that a hoe will not be needed, and this should be kept constantly in mind. Under the proper conditions one man and a team should be able to cultivate six or eight acres in a day. By using a two-horse corn cultivator, and exchanging the inner "shovels" for some more shallow-running plows, and using the "fenders," the crop would be cultivated as easily as a crop of corn. The common practice of using one horse and then leaving a considerable space around the plant to be hoed is a waste of time and energy. The great trouble with all one-horse plows and cultivators is that they have no "fender." This is simply a piece of sheet-iron fastened to the cultivator so as to keep the soil from being thrown on or against the plants, but allowing the finer particles of soil to settle in around each plant. When the cultivator passes on each side, the plant is pressed from both sides at once and so is not knocked over. Level cultivation will be found the better in our sandy loam. When plowing near the plants care should be taken not to injure the roots; this needs special care after the plant begins to blossom.

PRUNING.

In this State, where good tomato land brings $100 an acre, it is claimed that it will pay to trim and stake tomatoes. After planting out watch the plants and see that only one branch grows up, this will send the entire food supply in one direction, and will produce the first tomatoes earlier than to let the vine take its own course. We make the general statement that where tomatoes are wanted earlier, prune, but where the largest crop is desired do not prune.

STAKING AND TYING.

The long petioles of the cabbage palmetto leaves make good stakes to tie to. They are cheap and, when dry, light. Where the palmetto stakes cannot be obtained for the gathering it will be better to secure bamboo or cane stakes. These should be firmly set into the ground, and when the plants reach the height of from fifteen to eighteen inches the first tie should be made; the stakes need not, as a rule, stand more than two and a half feet above the surface of the ground. Any cheap form of twine or something of that nature may be used; it should not be sharp enough to cut the vines. By giving the twine a wrap about the stake, and then tying it to the stake before tying the vine, it will be found to keep its place, while to simply tie it will allow the loop to move up and down on the stake. The vine should not be tied so tightly that the string will grow into it. A boy can drive a team astride of a row while two or three men set the stakes, and the tying may be done later.

PICKING.

For distant markets it is difficult to tell just when to pick the crop so it will arrive there in the proper condition. Usually tomatoes will color up well in two or three days if they are full grown. The atmospheric conditions modify the time to some extent, but it is necessary to be more or less familiar with the time required by the particular variety that is being handled. A test of this may be made by keeping a quantity of the fruit on hand.

In gathering, all fruit that has reached a certain degree of ripeness should be picked. All culls and diseased fruit, either from fungus or insect attack, should be gathered and taken from the field. If there is not too much, the refuse fruit may be fed to stock; if there is more than can be eaten by stock the part that is not used should be buried deeply. It should not be used in composting; many of the disease spores would be taken back to the field, and insects would pass through their life cycle unharmed. It is certainly a very bad practice to pick the defective fruit and leave it in the field, and still worse to leave it on the vine.

Although it is not much practiced, it would pay to sort the crop into grades depending on the size and degree of ripeness. First grade, or large ripes, being wrapped in a fine grade of paper, and packed in the best crates. Second grade, or small ripes, might be wrapped or left unwrapped, depending on the market, and put into good crates. Third grade, large green. Fourth grade, small green. Finally the culls. By the term culls we should not understand that they are wormy or diseased, but that they are defective in some way that will not allow them to be classed among perfect specimens. These may be shipped to local markets if one knows that they will sell there, or they may be used in canning.

PACKING.

The final operation in tomato growing should not be carelessly done. By putting a few finishing touches on the last act the producer often makes a large per cent of gain in the selling price. It frequently makes enough difference to change the balance from one of loss to one of gain. This has been demonstrated repeatedly in the industry of growing oranges.

One thing should be kept in mind constantly, and that is that there is not time for leisure when shipping season arrives; everything has to be on the move. So all should be in readiness when this time arrives. The crate material should have been stored and sorted, if there is any chance for grading it. Enough crates should be made for the first shipment and be ready for use. A delay of twenty-four hours in sending out often means a loss of ten to twenty per cent on the selling price of the shipment.

In selecting the laborers for picking one has to use good judgment; a careless hand can easily waste or easily spoil an amount equal to a day's wages. He should not be employed, if it can be avoided. If he must be hired he may be most useful to do the heavier work of hauling and handling full crates, and to "set up" crates.

It is usually necessary to pick the fruit before it shows any signs of turning; in Georgia the growers can usually wait until the berry shows a slight tinge of red. The pickers gather the fruit into ordinary market baskets, which are emptied into boxes placed in the field to receive the fruit.

The picking boxes are about ten inches wide, fourteen deep and thirty long; they hold about two crates. It is best to leave no cracks open in making these picking boxes; it lessens the danger of brusing the fruit on the sharp edges. Near the top and on each end is nailed a cleat; these cleats serve as handles, and should run across the box to give additional strength. It is quite desirable to make these boxes large enough so the average man must give his attention to the work to handle it when full. Again there will be a gain in the man being able to do more work.

If one can have the packing-house so situated that the crates can be loaded directly into the car it will save one handling, and it will compensate for a haul of a mile, but if the full crates have to be hauled it is better to have the packing-house as near the centre of the crop as possible. There are a good many reasons why it would better be removed from dwellings.

Many persons do not recognize the expensiveness of having to lift packing-boxes on to an elevated floor, and then to lift these on to a high bench from which to sort and wrap, yet when we remember that this work is an absolute loss, we can see the force of an argument to make a careful plan for a packing-house.

It the tomatoes are to be sorted, it should be done immediately on being received at the packing-house. This place requires the best and quickest hand that one has in his force. Chutes may be made to carry the fruit to their respective bins from the sorters table. If five grades are established it will require that many chutes and bins to receive the fruit. The desirability of sorting will not be denied, but some may doubt whether it will pay. To these we will simply say that it will be carried much further within a very few years than it is at present. Much of the time spent by the man who grades the crop will be saved in the uniformity of the work of the wrappers. The grades of "*ripes*" and "*greens*" gives the grower a chance to distribute the product, while otherwise he would have to ship so the cargo would reach a market when the ripest were in the proper condition. Then the divisions of "*small* and *large*" will meet the requirement of any market better than any kind of a mixture.

The "large" should be wrapped and crated or wrapped and put into carriers; or they may be put into "*carriers*" without being wrapped. Whenever tomatoes are packed in carriers the blossom end should be placed up. It takes more time to pack a crate with the carriers, but there is enough gain in fruit (room occupied by carrier) to pay for the extra work, as a crate with carriers sells for just as much as one without.

The small are usually sold to boarding-houses, and the less wealthy, who expect to get as much as they can for their money. Defective large tomatoes may be sent out with these. In the early market only a few need to be sent to the cull bin. Later in the season it is necessary to throw more to the cull bin.

Handle tomatoes as carefully as you would handle eggs; any bruising may end in rotting, and a low price for your whole shipment. In this branch of vegetable growing one has to establish himself as well as in any other branch of horticulture, and it may be repeated with emphasis that it does not pay to enter it as a temporary occupation.

There is very little attention paid to our home market. The growers seem to have set their range of vision so as to over-shoot the money right at their doors. To be sure none of these small cities can consume more than a few crates a day, but if a regular trade were worked up there would not be so much canned goods shipped into the State. Gardening sections in other States pay more attention to this trade than is usual in our communities. Good tomatoes can be grown throughout a considerable portion of the year, and a local market will take these when it does not pay to ship. A shrewd man can sell fresh tomatoes several months after the last have been shipped to the distant markets.

KINDS TO SELECT.

In selecting varieties it makes a great deal of difference whether one lives near the market or far from it, or whether one wishes to use the crop for canning or for other purposes.

Florida growers should not choose a yellow variety nor one that does not color up evenly.

Mr. A. W. Livingston, who is our best authority on tomatoes, gives the following as the best shippers: "For early red, *Perfection* and *The Aristocrat*, especially in those parts of the country where staking up is largely employed. The *Beauty*, of purple color, comes next, and should be given place for one-half of the whole crop. *New Stone*, for bulk of crop between early and late. This is a red tomato, and very choice for this purpose. And *Paragon* for late red."

For market garden, *Acme*, *Perfection*, for early red; *New Stone*, *Beauty*, for medium, and *Paragon* for late. The *Buckeye State* is also good, but not so good for shipping.

For home use there is possibly a greater latitude than for market, either distant or home. *Favorite* is a good red variety. *Beauty*, *Golden Queen*, *Royal Red*, *Potato Leaf*, and others, are good.

CANNING.

The subject of canning tomatoes has been discussed, and a great deal of advice has been given on that subject, and communities condemned as not progressive because so many tomatoes were allowed to waste in the field. Speaking from contact with canning factories, I think this allowing tomatoes to rot is rather commendable than otherwise. It is not an easy matter to convert oneself from a tomato-shipper to a tomato-canner. It requires experience, skill, forethought and close economy to make it pay for a factory to buy tomatoes at twenty-five cents a bushel (crate). At this price, the tomatoes must arrive at the factory in a constant quantity daily, so that hands are not idle for want of tomatoes on the one hand, and on the other hand that the force may be able to work up all that comes in. Ripe tomatoes handled roughly and lying in large piles rot in a short time. Another consideration is that the plant in most districts would be idle for about ten months. As soon as we shall diversify our vegetable and fruit crops so there will be material to can and dry for six, eight or ten months in the year, factories for these purposes will be established. This whole matter has been considered very carefully by persons of means with a view of engaging in this business, but it is yet too uncertain to warrant the investment of the required capital.

BULLETIN NO. 32. JANUARY, 1896.

FLORIDA EXPERIMENT STATION.

Cotton, Its Cultivation And Fertilization.

A. A. PERSONS.

PRELIMINARY.

The very large number of inquiries which have recently been received at the Experiment Station office from parties unfamiliar with cotton growing, and who are seeking information in regard to the cultivation and fertilization of Sea Island Cotton, are clearly indicative of the fact that it is the intention of Florida farmers to increase the acreage of this market crop the present season.

Since it is manifest that the cotton acreage is to be increased, it has been thought best that this Station publish immediately a brief bulletin on the system of cultivation that should be applied to the cotton plant, and also suggesting certain economical fertilizer formulae which experience has shown to be best adapted to producing the largest yield of cotton at the least expense.

Soils adapted to Cotton Cultivation.

As to the ideal cotton soil there is some difference of opinion. It is well known, however, that a sandy soil of level character and containing sufficient humus will produce excellent cotton, as will clay loams and sandy loams resting upon clay subsoils. All should contain a fair amount of vegetable matter (humus).

Preparation of the Soil.

It is always necessary that the soil receive deep and thorough preparation, followed by pulverization, preparatory to to the planting of cotton. After this thorough preparation of the land the fertilizer is either uniformly distributed, broadcast, over the area, or else, (in the case of moderate applications) withheld to apply subsequently in the drill, and the land is then made into full beds. Ordinarily these rows (beds) should be four feet apart, but if the land will produce as much as twenty bushels of corn to the acre, the rows can be made wider—say four and a-half to five feet. After thus being converted into full beds, a harrow should be drawn over them. This will serve to pull all trash and clods into the middles while broadening and flattening the beds.

Fertilizer for Cotton.

It is well understood that phosphoric acid is the most important element of plant food to be applied in a cotton fertilizer; nitrogen ranks next in importance, while potash is required in smaller quantities than either of the other two. The required proportions of each of the ingredients are about as follows: 2¼ parts of phosphoric acid to 1 part of nitrogen and ¾ part of potash.

With these proportions as a basis, the following would prove an excellent fertilizer to be applied, per acre, on a comparatively fertile soil:

100 lbs.	Acid phosphate, (containing at least 14% of available phosphoric acid).
100 lbs.	Upland (bright) cotton-seed-meal.
50 lbs.	Kainit.

This application should serve to produce a good yield, while, at the same time, the fertility of the soil will be maintained.

If a nitrogen-gathering crop, such as the pea, bean, or clover has been grown upon the land the previous year, one-half of the quantity of C. S. meal, recommended above, can be safely dispensed with, but if no such crop has been grown, then a complete fertilizer, proportioned as above, will be found most satisfactory. It is best, on the average Florida upland, to apply the quantity of fertilizer recommended above, in the drill. If a larger quantity is used, (which may be often necessary on very poor upland, sandy soil) it should be broadcasted over the open furrows before bedding, as has been previously intimated. On such lands the quantity of each constituent should be increased from 50% to 100%—according to the degree of impoverishment. A large proportion of the soils of Florida employed in growing cotton are known to be deficient in organic matter (humus); which, of course, greatly detracts from their productive capacity. Muck is known to be an excellent material for supplying this deficiency, as is also stable manure. Before employing the former, however, it should first be dug out of the beds and piled into heaps to undergo the "weathering" process, which will require at least several weeks. Afterwards, it can be composted with stable manure, half and half, and the two subseqently applied together (one to two tons per acre) broadcast over the soil preparatory to bedding. When this compost is employed—which should always be the case where thin, upland, sandy land is being cultivated—the quantity of fertilizer recommended above can, of course, be proportionately reduced.

Materials Useful for Supplying the Essential Plant Foods.

Below is given a table of important fertilizing materials that are commonly used for supplying deficiencies of phosphoric acid, nitrogen and potash in soils. It will be observed that no one of the separate materials mentioned in this table can be depended upon to supply all of the three plant-food essentials in proper proportions. Each has its own mission; one to supply the necessary Nitrogen, another, the necessary Phosphoric Acid and still another the Potash.

The materials commonly used as sources for obtaining the necessary phosphoric acid are bone-meal, acid phosphate (raw mineral phosphate rendered soluble by treatment with Sulphuric Acid), and finely pulverized raw phosphate. The latter is probably best to employ where the soil is already comparatively fertile, and, hence, where the plant does not have to depend solely upon the phosphate material applied for its phosphoric acid nourishment. Where land is known to be very poor, so that a crop must depend almost entirely upon an application of fertilizer for nourishment, then the acid phosphate should be employed. Nitrogen is applied as a fertilizer in either of the following forms: Nitrate of soda, Sulphate of Ammonia, Cotton seed meal, Cotton seed, Dried Blood, etc.

Potash is usually employed in one of the following forms: Sulphate of potash, Muriate of Potash, Kainit, Cotton Hull ashes, Wood ashes (unleached). Ashes obtained from burning the root of the saw palmetto are an excellent home source of potash, containing approximately 43% of this ingredient, and about 20% of phosphoric acid.

Stable manure, alone, although not economically proportioned for a cotton feetilizer, when applied in sufficient quantities (two to four tons per acre), is an excellent cotton fertilizer, since it contains each of the three plant-food essentials, in addition to humus.

PERCENTAGE COMPOSITION OF DIFFERENT FERTILIZING MATERIALS.

	phospheric Acid.	Nitrogen.	Potash.
Acid Phosphate (contains available phosphoric acid)	14.00	-----	-----
Bone Meal	23.25	4.05	-----
Raw Florida Phosphate	21.50	-----	-----
Nitrate of Soda	-----	15.70	-----
Sulphate of Ammonia	-----	19.50	-----
Cotton Seed Meal (decorticated)	3.10	7.10	1.80
Cotton Seed	1.02	3.07	1.17
Dried Blood	1.91	10.50	-----
Sulphate of Potash (high grade.)	---	---	50.00
Muriate of Potash	-----	--	50.00
Kainit	-----	-----	12.50
Cotton Hull Ashes	6.50	-----	22.75
Wood Ashes [unleached.]	--	-----	5.25
Saw Palmetto Ashes	20.00	-----	43.00
Stable Manure [mixed]	0.30	0.50	0.60
Muck	-	1.10	-----

Either of the special materials above may be substituted for those previously mentioned in the formula; i. e., Nitrate of soda may take the place C. S. meal, etc., taking into consideration, of course, the difference in per cent of nitrogen contained in the two, and making the deduction in the quantity used accordingly.

If the meal from the Sea Island Cotton Seed is employed instead of Upland Meal, about twice the quantity will be required, since the former only contains approximately half as much Nitrogen.

WHAT SEEDS SHOULD BE USED IN PLANTING?

The four valuable properties of cotton, we may say, are strength, length, fineness and evenness of thread, and the best seeds for producing such cotton are from full grown pods, on healthy stalks. The best seeds are usually from the middle bolls.

Experience demonstrated long ago that in order to maintain the best fibre in cotton, new seeds should be obtained directly from the Sea Islands at intervals of several years. It is the concensus of opinion that a renewal of seed in this way at intervals of two or three years will produce satisfactory results. The following cotton dealers can furnish fresh seed for planting directly from the Sea Islands at all times: Col. J. E. B. Stoan, Charleston, S. C.; H. F. Dutton & Co., Gainesville, Fla.; W. W. Gordon & Co., Savannah, Ga., and Messrs. Butler & Stevens, Savannah, Ga. They can doubtless be procured from either of these gentlemen upon short notice and at about the rate of $2.00 per bushel.

HOW TO PLANT THE SEED.

The planting of the seed should be accomplished by means of some of the excellent and cheap cotton planters which can now be easily purchased almost anywhere. When a planter is employed in dropping the seed, one-half bushel per acre will be required. When planted by hand it is necessary to use about three pecks per acre in planting.

The best variety of planter to employ is one having a roller attached in the rear to press the soil upon the seed. This will insure more prompt germination and more uniform vegetation.

CULTIVATING THE CROP.

As soon as the first true leaf of the young plant appears, the cotton rows should be sided closely with a sixteen inch Terrell heel, scrape with narrow wings and set to run very flat. In the absence of the Terrell heel, scrape, any old scrape that has been well worn at the extremities will suffice. The object of this siding is to stir the soil around the plants and to sift enough fine soil amongst them to cover the young grass growing in the drill. Leave it in this condition long enough for the young grass thus covered to die and then chop the cotton to a stand. It is a prevailing opinion that, when it is possible to avoid it, chopping should not proceed in exceedingly windy or chilly weather. The distance apart to leave the stalks in the row in chopping will depend chiefly upon the fertility of the soil and the rain supply. On poor lands, or on lands subject to drought during the planting season, thin planting must be practiced to obtain the best results. Varying, therefore, with the fertility, etc., of the soil, the cotton should be chopped to a stand wherein the stalks are from ten to eighteen inches apart. The chopping should be followed with a wider scrape—26 or 30 inches—throwing enough soil to the cotton to support it and to cover any grass left by the choppers. Two furrows with a wide scrape will cover the whole middle. After every rain, as soon as the ground is dry enough, the scrape should again be brought into use to prevent the formation of a crust and to kill the grass in the germ.

If this system of cultivation is carefully employed, very little hoeing will be required after chopping to a stand. The scrape, of course, should be worked under the foot of the plow, using a short scooter, or bull-tongue above to make the point. When properly adjusted, if the plow is placed upon a level surface, the point of the scooter and the entire edge of the scrape should touch the surface.

The picking should of course, be carried on as often as necessary. It is not a good idea to allow cotton to remain long open in the field.

The Bulletins of this station will be sent free of charge to all

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Bulletin No. 33. February, 1896.

FLORIDA
AGRICULTURAL EXPERIMENT
STATION.

Present Condition and Treatment of
Orange Groves.

M. S. MOREMEN.

The Bulletins of this Station will be sent free to any address in
Florida upon application to the Director of the Experi-
ment Station, Lake City, Fla,

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INTRODUCTION.

In looking over the industrial interests of Florida it seemed to me that no more valuable work could be done for the State than that the present condition of the orange groves should be carefully examined by an expert orange-grower, that he should consult with the most successful owners of groves, and that the opinions as to the present management reached by his observation and consultation should be published for the common good. To do this important work I was able to secure M. S. Moremen, of Switzerland, whose long and successful experience in orange culture, coupled with his conservative temperament eminently fitted him for the service. The result of his work is herewith published, with the belief that it will prove a valuable aid in the development of Florida.

Special acknowledgements should be made of the kindness of the officers of the F. C. & P. R. R., and of the J. T. & K. W. R., who willingly gave passes over their lines to Mr. Moremen. Similar courtesies have often been given the Station staff of workers by these and all other railroads in the State. Doubtless the other roads would have been equally generous in this case, had they been asked.

O. CLUTE, Director.

Lake City, February 4, 1896.

THE PRESENT CONDITION AND TREATMENT OF ORANGE GROVES.

Owing to the very unusual climatic conditions of the season of 1894–'95 the orange growers of Florida passed through an experience unknown to this generation, and, in fact, without parallel in the history of citrus culture in the State.

In preparing this bulletin upon the present condition and future treatment of the orange groves of Florida, every effort has been made to secure the most accurate knowledge by personal examination in the several sections, and by interviewing as many as possible of the leading progressive growers. It is not intended to give in detail the conditions of the various sections, or the treatment that may best suit any special soil or district. Such a task would be herculean and impracticable. The object is to convey the best general knowledge of the present conditions and of the events that have produced them, and to suggest treatment that will, in a large measure, be of benefit in every locality, leaving to the growers to determine the special differences that may exist in their groves from the conditions herein presented, and the special treatment needed other than that recommended. The importance and the difficulty of this work will at once impress the minds of practical men, and the writer therefore asks for friendly judgment.

PAST AND PEESENT.

Nothing can more forcibly call attention to the fatal effects of the severe weather of last winter than to contrast the beautiful fruit-laden groves as seen in December, 1894, with the seared and desolate scenes that remained after the passage of the death-dealing blizzards of December, 1894, and February, 1895. The horticulturist had acquired knowledge of the skillful culture of citrus fruits, as was evidenced by the thriftiness of the trees and the abundance of the harvest. The great freeze of 1835 had become a dim tradition of the past. So complete was the confidence in the minds of men that few believed that these flourishing trees would ever be destroyed in their time. Therefore cheerfulness and contentment, companions of prosperity, were blessing the people. On the night of December 28, 1894, over this picture of beauty, prosperity and happiness, the blighting north wind passed, stripping from the groves their beauty, and destroying the ripe fruit with which the trees were laden, but doing no permanent injury to the trees. Remarkable for its recuperative powers, as soon as exposed to the direct rays of the sun by the loss of foliage, this wonderful tree sprung into active life, sending forth new leaves, and, in many places, myriads of fruit buds.

The anxious husbandman, desiring an early restoration, sought to hasten it by cultivation and fertilizing. Under these influences an early and exceedingly abundant flow of sap in the trees was produced. While the freeze of December found the trees dormant and protected under a canopy of matured foliage, on February 7, 1895, all conditions were changed; so that the same degree of cold (14° at Jacksonville), which did but little injury to the trees in December, on this memorable night killed them to the ground, with but few exceptions. The destruction in December was about two-thirds of the fruit crop; in February it was almost the total destruction of the tops of all the trees in the northern and central parts of the State.

Slowly realizing the extent of the vast destruction wrought, men seemed dazed, and knew not what course was best to pursue. There was no past experience to guide them. An overwhelming calamity had come upon them such as seldom visits a people. Destruction and ruin staring them in the face, these people did not give over to despair, but with a heroism much akin to the tenacious vitality of their trees, they set forth to conquer adversity, and to rebuild their ruined fortunes as best they could. Unaided they will conquer, and woo back prosperity with all of her companions. Again these groves will give forth their fragrance and gladden the people with a golden harvest.

PRESENT CONDITIONS.

Could a bird's-eye view be had of the orange country, looking from the northern border to the far south, where flow the St. Lucie and Caloosahatchee Rivers, mutilated and destroyed groves would, for the most part, meet the gaze, until near this southern limit, where the trees were but slightly injured. Passing southward from district to district, the same general description is true, except that as the south is approached the number of trees killed to the ground lessens, and the frost damage is to be seen mostly in the tops and branches. A general description of each section would be as follows, mention being made of special conditions overlooked in the general view:

On the northern border of orange production lies Bradford County, which has never been considered much of an orange district. Yet while there are few, if any, large groves, annually many thousand boxes of oranges were shipped. The trees were principally seedlings, which grew near the farm houses and barns, and were fertilized by the waste of the premises. With little expense to the owner, oranges were produced, adding a satisfactory sum to his income. Nearly all of these trees were killed to the ground, but have sprouted well upon the roots, and promise, with normal winters, in a few years to be yielding their usual crop. So the acreage of this section will be restored.

Hawthorne and Interlachen, situated in a rolling pine country, also had their groves practically cut to the ground. Here there is now in many instances a fine growth from the roots, and it will in due time make thrifty trees. Here, as elsewhere during the first months of the year, a vigorous growth started on trunks and limbs. But these sprouts from trunks and limbs for the most part died, and those which remain are not considered a good foundation for the future tree, except in a few instances. These exceptions promise bloom for the coming year.

Southward is the Orange Lake and Micanopy country, famous for its rich soil, being principally hammock, and in the past the greatest orange-producing area of the State. Here natural groves of the wild or sour orange abounded. During the '70's the greater portion of these native trees were budded, and from them some of the most famous groves of the world were produced.

Island Grove, Bishop, Hoyt & Co., Orange Lake Fruit Company, White, Kells, Borland Bros., Sampson, Barr, Montgomery, and many others too numerous to mention, are names which suggest broad acres of orange trees and thousands of boxes of luscious fruit. From this section something like 800,000 boxes were annually marketed. In one night this vast industry was swept from the earth. So closed an epoch of most wonderful prosperity to these people. Believing what has been done in the past can be repeated in the future, it is gratifying to see with what energy and confidence the work of restoration is being pushed forward so that flourishing groves will soon again cover these fertile lands.

Passing southward the same history continues true of the larger portion of the groves, practically all being killed to the ground, or dying back to the roots after this freeze, having new growth about the collar in all stages, from the bursting eye to the shoot of five feet or more.

In the water-protected and forest-protected groves in the vicinity of Leesburg the tops of many of the trees partially escaped. In some instances a few oranges were seen this winter among the rank growth. From appearances it is fair to predict that Lake County will have oranges to ship in 1896. Indeed the crop for next year is estimated at about 10,000 boxes. Beyond the region of the large lakes of Leesburg is western Orange County, a locality heretofore peculiarly exempt from injurious frosts. However, the general condition of groves is now about the same as found elsewhere. Every district has its favored places, so on Lake Apopka as at Leesburg, forest-protected and water-protected trees will yield some fruit next year. One thing to be particularly noticed in this section is the success of the root-grafting practiced by Mr. D. W. Adams, near Tangerine. These grafts, put in last February, made a fine growth, appearing in December as well-grown trees of five or six years. Mr. Adams anticipates bloom next spring, and possibly some fruit may set.

From Wildwood southward there is no reason to change the general description as to condition of groves, since all have fared about alike, until near the Tampa section, where it is noticeable that the number of trees that partially escaped has largely increased. Especially is this true of the sub-peninsula, there being some oranges in the neighborhood of St. Petersburg this season.

The section of country south of the South Florida Railroad from Kissimmee westward can show a much larger proportion of partially injured and uninjured trees than any other part of the State. It is noticeable that, as you travel southward, the proportion of trees killed to the ground grows smaller, while the number sustaining injury only in the top rapidly increases.

Entering the Manatee River section the first trees are seen that escaped the blizzard's touch. Probably it is not quite correct to say "escaped," for on account of the damage done by frost, little or no fruit was produced this year on the north side of the trees. Nor must it be supposed that all the trees escaped. For the most part the trees immediately upon the banks of the river were but little damaged, while back on either side of the river many trees lost from one-half to two-thirds of their tops, and not infrequently trees were killed to the ground even here. So far as observed lemon trees were universally killed to the ground. From this Manatee country about one-third of the usual crop of fruit is being shipped this season—estimated at 28,000 boxes. It will take the groves of the Manatee country some two years or more to reach normal conditions and produce the former amount of fruit. It is proving indeed a golden harvest to these people, prices obtained being from $2.25 to $2.75 per box on the trees.

Entering DeSoto County we find many groves showing but little injury and producing some fruit this season. Though so favored there was still damage done, for some trees here are also killed to the ground. The growth here this summer has been fine. The crop of DeSoto was about 2,000 boxes. There is every reason to believe that the crop will be much greater next season.

Lee and Manatee Counties stand in marked contrast to the balance of the orange-producing sections. In Lee, as described for Manatee, are trees practically without any frost damage. Upon the broad Caloosahatchee River these trees are safely beyond the visitations of injurious frosts. While the blizzards reached this section they touched it lightly. Lemons and limes record its passage by the loss of a portion of their tops. There is no injury to orange trees to mention, more than that some bloom was cut off in February, lessening the crop slightly. One is impressed that this is the ideal orange country on beholding the magnificent trees and rich soil as seen in the high hammock lands along the river and tributary creeks.

A visit to Orange River, just above Ft. Myers, gives an insight to the future prosperity that has already dawned upon this country. The crop of oranges shipped from the

Caloosahatchee this year was about 20,000 boxes. It will rapidly increase, as changed conditions have made this section an orange center.

Indian River has in the past been a synonym for tropical growth and balmy breezes of the Southland, but the ruthless freezes of last winter heeded not tradition, neither stayed the work of destruction when entering this favored region. Rockledge, where the famous Indian River orange was grown in greatest abundance, with its groves nestled in the protecting care of a forest of palms, felt the blighting touch of the blizzards. Its groves are as others—killed to the ground, with more or less exceptions, as is the story of nearly all sections. Thus it is at City Point, Titusville, New Smyna and Daytona, and so on northward to the "Old City." The path of destruction is marked by the same frost-prints. "Dead to the ground," here and there a more hardy or more fortunate tree was partially spared, with now and then a section of a grove. Throughout this region there has been, during the past summer, a good growth from root or trunk, and in some instances such has been the growth from trunk or limb above the bud that fruit will mingle with the foliage next year.

Away to the southward upon the banks of the St. Lucie and lower Indian Rivers, are lime, lemon and orange trees showing but little injury from frosts, as well as trees upon the southern end of Merritt's Island—all of these places having some fruit.

Orlando and the eastern section of Orange County present about the same features as described for Western Orange, and sections to the northward. Trees are practically dead to the ground, with some noticeable exceptions. The Anchorage at Winter Park has something of the appearance of a grove. Some other groves look nearly as well. There will be some oranges in this county in '96, and no doubt some shipments in '97.

Passing from Sanford to DeLand, we come to the country of transplanted groves. As the Orange Lake country is pre-eminently the home of the natural groves, DeLand is equally notable as a transplanted grove section. Over the greater portion of the orange districts it is simply wonderful how evenly the work of the frost was done. Excepting the extreme southern localities, there is little difference to record, whether in transplanted or natural groves. Here at DeLand, as elsewhere, the same sad story is true. Nearly 100 per cent. have been killed to the ground. Here also are trees and parts of groves that are exceptions, for on trunk and limb some good growth is seen, giving promise of early fruitage. In fact, near Lake Beresford, in a forest-protected grove, a few oranges hang amongst the rich foliage this winter. The work of restoration will be undertaken here in earnest.

Coming northward to Crescent City, the groves upon the river and the ridge both felt the freeze alike—all, or nearly all, "dead to the ground." Here and there a tree or clump of trees with vigorous growth was seen throughout this section, with almost universal sprouting from the roots. Groves immediately on the shores of Crescent Lake showed the influence of water protection.

From Palatka northward the St. Johns River spreads its broad expanse, forming in the past a secure frost barrier. The blizzards of last winter regarded not its influence, but swept over its bosom, bringing destruction to some of the oldest groves in the State. Here were to be found great giants that linked this time with the dim, distant '35. Now, as then, all yielded to the arctic blast. Yet not all, for here also stand trees in clumps and alone, whose tops are more or less mangled, but not entirely dead, to tell the story of what had been once prosperous days. Upon these shores it is probable that orange culture was first undertaken. Many a tale of orange lore is told. On this northeastern border of the Orange Belt large groves flourished, producing abundant crops of fruit. In the months of spring the trees put forth on trunk and limb, only in most instances to die back, to come again from root and stump, making a fine growth foreshadowing the coming tree. This section will also restore its groves, not lagging behind other sections. Here also are a few trees which will produce fruit next season, being scattered along the banks of the river nearly as far north as Jacksonville, in groves favorably located as regards water and forest protection.

From district to district was the journey made. I have given in description the conditions as seen. It will require a few years of labor and patient toil to restore that which was destroyed in a night.

TREATMENT.

Now the difficult part of this task is reached. Under normal conditions, theories and practices regarding the treatment of groves differ widely; hence to secure agreement, or rather to outline a course of treatment that will receive the endorsement of a majority, under the present abnormal conditions, seems a hopeless undertaking. However, the ideas of those who, heretofore, have been successful in orange culture will be given. It is hoped that aid will be thus afforded to those undertaking to rebuild their groves.

There can scarcely be a doubt but that the first orange tree cultivated in Florida was a sweet seedling, and it is quite as true that oranges from these trees laid the foundation of the good reputation the Florida fruit has for superior qualities. The sweet seedling tree is held in high esteem by many growers, and its treatment is of first importance.

Many seedling trees partially resisted the cold, so that on trunk and limb a growth of sprouts appeared early in the spring of '95. Many of these during the summer died. On examination large blisters would be found on the trunk, or perhaps a portion of the trunk would be dead to the ground; other trunks were perforated by borers. Sprouts upon such trunks will not form satisfactory trees; they will, for several years, give promise, but in the end be a disappointment. Such trees should be cut close to the ground in order to force a vigorous growth from the roots, and stop the waste of energies by sprouting upon injured wood. There are seedling trees that have fine growth on trunk and limb that have no injury. There is no doubt that these will make reliable trees. There can be no advantage to the tree in cutting away the dead wood, since a growth on sound wood is already secured. In fact, leaving the old top on is an advantage, being a support to the long growth that will come. Again, many seedlings were killed to the ground. In this case nothing will be gained by cutting away the dead wood, since the growth must and will start from the sound roots. These old tops will fall away, gradually decaying. thus furnishing a little food for the coming tree.

By far the greater portion of the seedling trees will come from sprouts upon the roots of the old trees. Instead of selecting one of these sprouts and training it for the future tree, with a trunk several feet up to the crotch, it is better to let several of these sprouts grow, distributed about the stump, forming a head without a trunk. In order to be secure against the splitting off of any of these sprouts, when in the future they are bearing fruit, take lateral branches near the base of these sprouts and intwine and insert their ends under the bark of opposite sprouts. These will grow and make a fine base for the head of the tree. Where sprouts upon the trunk of the old tree are left to form the new head, it will be best to leave it to nature to dispose of the old wood and provide for the healing of the part where the dead wood will ultimately fall away from the live wood.

After the sweet seedling, comes the budded tree. Many seedling trees that produced fruit before the calamity were not prolific, or failed to produce fruit of a desirable quality. All such trees, with all sour stock, should now be budded to such varieties as are known to be profitable. There is no new feature in budding the trees, beyond this: that, instead of training trees to have trunks of several feet in height, the top should be formed at the ground, as is indicated for the seedling. Sprouts for budding should be selected, distributed about the old stump, and budded in the usual way. Lateral branches may be inserted into opposite sprouts for the purpose of securing a strong head to the tree, as with the seedling.

Budding should be done as early in the season as possible. The difficulty of securing budwood after the spring growth begins delays budding until May or June. To provide against this delay, select budwood the latter part of January or first of February, before the sap has started. Wax the ends of the sticks, put into dampened, *not wet*, moss, or partially dry sand, and put away in a dry, cool place. Examine occasionally to see that the sticks do not get too dry. These buds will be ready for use as soon as the stock is in condition for budding.

Proceeding to the matter of cultivation, two methods are pursued. Both seem equally efficient in obtaining the desired result of producing fruit.

Many successful growers think the groves should have thorough cultivation, beginning with plowing, and continuing to late in the summer, with frequent surface cultivation. Their reasons for this are that there are no fibrous or feeding roots in the soil; by a thorough working the trees can more readily replace these roots than can be done in an unbroken soil; also that a better supply of moisture will be secured, and some nitrogen will be gained.

Those advocating no culture, mulch the ground with vegetable matter in some form, claiming that the soil is lightened sufficiently for the formation of fibrous roots, and that moisture is even more certainly secured and some fertilization is obtained from the decay of the vegetable matter.

No matter which method is pursued, the guarantee of success is made good by an abundant supply of plant food. The question to be determined by each individual grower for himself is this—whether cultivation, with purchase of fertilizer, or mulching, with more or less purchase of fertilizing elements, is the cheaper method of furnishing the requisite plant food. If properly pursued, either plan produces fine trees, with abundant fruit. Economy of method should determine the selection.

In the event cultivation is the plan adopted, the soil should at once be stirred to the depth of four or five inches; by the first of March an application of fertilizers should be made where sprouts are starting. Nitrogen should predominate in all applications during the first months of the season; afterward less nitrogen and more potash. The applications should not be in large quantities, but in small doses frequently administered, beginning in February, or early in March, April or first of May, and six weeks after in June. Then potash should be applied in August to harden the wood. After the first deep stirring, surface cultivation should be followed up until late in summer, in order to hold grass and weeds in check so that trees may have first chance at the fertilizer applied.

In mulched groves there is a mass of decaying weeds, leaves, brush, etc., furnishing food for the trees. Those who advocate this method believe the supply of potash is sufficient, but nitrate of soda should be added in small quantities from time to time, say, beginning in February, and every six weeks add another portion. From two to four pounds to the tree will be enough for the season. Grass and weeds will be allowed to grow throughout the year, being mowed at the close of summer and in the autumn. The work of adding debris is done at any time to suit convenience. The one thing to be remembered is, plant food must be supplied. The success of either method in the production of fruit depends upon the supply of proper plant food.

Which method is best to pursue depends upon that which to you is the most economical.

After this season, provided our winter is normal, no unusual conditions will occur. The methods heretofore in vogue will answer all purposes.

Those stumps that have not sprouted could be grafted to advantage during February. These grafts will in many instances start before the sprouts. Much time can thus be saved over the plan of waiting for shoots into which to bud. I here print the greater part of Mr. Adams' article giving direction for root grafting.

GRAFTING THE ORANGE.

I am just in receipt of your note asking me to give information about grafting the orange. I am very glad indeed to use your columns for this purpose, as I am receiving so many letters of inquiry on this subject it has become quite a tax on my time to answer them separately.

The orange is one of the easiest trees to graft, and any of the numerous methods of grafting can be successfully used. The same principles are involved in all, however much the mechanical devices may vary.

1. The cions should be of perfectly dormant, well-ripened wood, that of the last year's growth being preferable. If the stock is dormant, or nearly so, all the better, though some measure of success with citrus fruits may be expected after the stock has begun to grow.

2. The cion and stock must be joined so the inner bark or cambium of the two shall join at some point, and the more points the better.

3. By some means enough pressure must be had to press those points together quite firmly.

4. The union must then be protected from drying by applying wax, clay, moist soil, or any other substance that will prevent drying of the cut surface.

Any method of grafting that will fulfill these simple requirements will be successful.

In grafting very small stocks, one-half inch or less, I use a side cut; then tie tightly by wrapping twine or matting several times tightly around and tie securely; then wax air-tight, or cover to top of the cion with moist soil, well packed down.

Stocks ½ to 1½ inches are readily grafted by the old-fashioned cleft graft.

Very large stocks are more readily worked by cutting off smooth and inserting the cion between the bark and wood. The cion is sloped off to a point with a slope ¾ to 1¼ inches long (owing to the size of the cion), all on one side, and inserted the whole length of the cut, with the cut side next to the wood.

It will be noticed that all citrus stumps are not round but irregular.

If the cion is inserted at a convex place the bark is apt to split, but if inserted in a flat or concave place, this danger is avoided.

Grafting can be done under the ground, or at any convenient height, but if frosted trees are grafted, be sure and go down to perfectly sound wood.

DUDLEY W. ADAMS.

Tangerine, Fla., Jan. 6, 1896.

Throughout most parts of the State banking was resorted to in the fall by many of the careful men, to protect the tender sappy growth from damage by frost. Very little of the late sprouting was sufficiently matured to resist a light frost. Under normal conditions matured dormant wood will not be injured by a temperature of 20° above zero. As every effort will be made the coming season to force a rapid growth, very much of it will neither be matured nor dormant when next winter comes. The prudent grower will insure at least a portion of this growth by banking. There is no insurance so cheap or half as good as banking with earth.

VARIETIES.

Through years of experience and the labors of the Horticultural Society, the question of variety has been satisfactorily determined. The growers of each locality have grown one or more varieties that have been eminently satisfactory. Of course, these will be rebudded. Such trees as failed to yield fruit of a desirable quality should be budded to such varieties as are known to be excellent. Should advice be offered on this subject it would be to the effect that the best early varieties should predominate in those places where freezing weather is feared, and where low temperatures do not frequently occur, the later varieties should be grown. Now it is not within the province of this bulletin to name the frosty or frostless districts where the early and late varieties should be grown, since every one knows the frost record of his own section, and should not deceive himself in this matter. Should the budding of early and late varieties be entered into to any great extent, the marketing season would be materially lengthened, and there would be no occasion for crowding the market, even when 5,000,000 boxes are again produced.

The reputation of the Florida orange has been gained by the matured oranges sent to market. For the most part shipments of fruit from any section, previous to December, generally realize green-fruit prices, while the fruit held until perfect maturity was reached, sold for remunerative prices. Some localities became famous for their maturec fruit, which resulted in great pecuniary gain. So the poin is, if you intend to ship your fruit in the autumn, select suc varieties as will reach maturity sufficiently early to suit suc practice. However, it must be remembered that at this season the markets are full of apples, pears, late peaches and other Northern fruits. Besides, the fruit-eating public is scarcely ready for the orange until December and later. Yet matured autumn oranges will bring remunerative prices as has been shown in the past. The mid-season oranges should form by far the larger proportion of the new budding, since among these is found the acme of perfection, and they retain their superior qualities during several months without deterioration, giving ample time to market a large production without any need of causing a glut. Many locations will carry the orange well into the spring, thus keeping up a constant supply until the late varieties are ready to go forward. Could the new budding be so regulated as to furnish oranges from October until July, an over supply in the markets could be avoided, and the profits of the industry maintained throughout the season, and even when the crop again becomes large.

It is hardly profitable to discuss in this place the several varieties suited for the successive seasons, since this has been so ably and completely done by the Horticultural Society of the State, the report of which is now available for every grower in the State, it being in pamphlet form.

Grapefruit shipments formed about one-fourth or between 6 and 7 per cent. of the citrus fruits shipped from the State. For this quantity there was a good demand and paying prices received. This fruit had not, however, entered into general consumption, or become a staple like the orange. While exceeding popular amongst those by whom it was known, yet doubts are entertained whether or not an increase of production to any great extent would not be over-production, and cause it to be unprofitable.

From data collected it is fair to infer that some 15 to 20 per cent. of the new budding is intended to be grapefruit, thus more than doubling the future production.

Of course this discussion of the profitableness is based upon the assumption that in a few years great crops will again be produced. In the meantime, while production is far below demand, the fruit of all seasons and varieties will be remunerative. But we are laying the foundatation of another epoch that will doubtless extend over sixty or more years. Let us, therefore, lay it wisely, giving to each season its proper supply, as well as making a judicious selection of varieties to be grown.

For the benefit of those who may not procure a report of the Horticultural Society, a brief list of reliable varieties suitable for the different seasons is given:

For the autumn shipping, the Centennial, Parson Brown, Boone's Early, Nonpareil, Homosassa, Tangerine, Mandarin and Satsuma.

For the mid-season, Jaffa, St. Michael, Maltese Blood, Majorca; and in rich hammock lands, Pineapple.

For late, Hart's Tardiff, King, Valencia Late.

CONSIDERATIONS.

The Freezes.—The trees were but little injured by the cold wave of December, 1894, being dormant and protected by the foliage. Had this freeze not have occurred, then that of February would have done but slight, if any, damage to the trees, since they would have remained in a large measure dormant, and have had their protecting leaves. The intervening warm, damp weather, and the defoliated condition of the trees induced a sappy growth, thus preparing the tree to become an easy victim to the power of the blizzard. It took twin blizzards to damage Florida'a orange groves.

Will It Pay to Restore Groves?—Some twenty years ago men thought it would pay to purchase land, clear away the forests, buy nursery stock, plant groves, cultivate and fertilize them for seven or eight years in order to produce this Florida orange. Did it pay them? Could you look back some twenty years or more and see the hardy pioneer enduring his hardships in his rough surroundings and compare the scene with the beautiful homes now scattered all over the land, filled with cultivated and refined people, your answer would be: "Those men did better than they knew." All now realize how excellent was the investment. Groves, judiciously managed, had a value of five hundred dollars an acre, and for many groves this price would have been declined.

These pioneers had everything to do; a large venture to make, requiring years to complete it and test its value; homes to build; the soil to test; transportation to secure. In nothing did they fail. Their fruit has now a world-wide reputation. These pioneers toiled through weary years up to their success.

The orange grower of to-day finds much in readiness for him. The land is in order; there are well-established roots in the soil. To restore these groves will be far less labor and expense than the pioneer undertook. Surely it will pay to restore them, since so much is already done in that direction.

Have We Not Fared the Best?—As I passed from section to section this question was often asked. The mercury fell to such a point throughout the peninsula, that local influences, which heretofore afforded protection against frost-injury, proved to be of but slight value this time. The number of partially escaped trees increases as the southern limit is neared. Over the whole northern and central parts of the State the frost-work was quite evenly done. It is not until well south of the South Florida Railroad, west of Kissimmee, that any marked change in the condition of the groves is noticed. This probably results from the fact that in this section the day, the 8th of February, succeeding the cold night was cloudy, with frequent showers of rain or snow. Thus the intensity and damaging effects of the last blizzard were, in this portion of the State, partially neutralized. The record at Ft. Myers shows 24° above zero in

December, and only 30° in February, while in nearly all sections north of this district the record is about the same temperature for each cold wave. It is fair to infer, had precisely the same temperature been recorded at all points in February as occurred in December, the damage would have been about the same.

When Will Fruit Be Shipped?—Early in the '70's, when the great orange growing period began, the crop of the State was about 100,000 boxes. Groves were rapidly increased in number, both by transplanting nursery stock and by budding directly into the native sour trees as they stood. Behind this work was capital and hope, which pushed it forward with astonishing rapidity. Indeed the developments were marvelous. Under these auspicious conditions nearly twenty years were required before a crop of five million boxes was reached. This epoch of production was closed upon the night of February 7th, 1895. The crop of the State for this season does not exceed fifty thousand boxes. Instead of from new material, as was the case before, the coming groves must be made from the wreckage left by the wave of adversity. It is true the people are rallying from the blow, and hope springs again, backed by indomitable courage and energy. While recuperation in some instances must of necessity be slow, for the most part the growth on these well-established roots will be rapidly developed into fruit bearing trees. There will be no marked increase in the crop of the State until the budding done in '95 begins bearing, which is not probable earlier than '98. Of course, the trees that were not killed to the ground will, in the meantime, add their production, and thus give some increase. These trees, however, will not reach their full bearing for at least five years. Ninety-five per cent. of the old orange producing surface was destroyed. The remaining five per cent. was so injured that, instead of producing 250,000 boxes, its proportion, only 50,000 boxes were marketed. The crop of '96 may reach 125,000. This will increase each year, so that 1,000,000 boxes will possibly be the crop for 1900.

The Best Locality.—In any district ask the question: What proportion of the groves will be abandoned? Most generally the reply will be: "That this section in the past has shown itself to be eminently adapted to the growth of the orange, and our people believe there is no better place." So universal is this sentiment, one must conclude that many places are the *best* in which to have a grove.

Abandonment.—This is a sad contemplation. After all these years of labor, hope and realization, how sad it must be to say—*it must be given up*. By reason of the course of natural events, which no human power could stay, and because of no fault of theirs, some will be forced to abandon or so to conduct the work of recuperation that restoration will be delayed. So we see many a grove neglected, not from choice, but from necessity, and it may be correct to say that as much as one fourth of the old orange area will not again produce fruit for many years to come. It is more than probable that a decade, or even a longer period, will elapse before Florida produces such a crop as the blizzard of December 28th, 1894, destroyed.

What Should Have Been Done—It is the concensus of opinion that last February, immediately after the freeze, the damaged trees should have been cut to the ground, forcing a growth from the sound roots instead of allowing the energies of the tree to be wasted in the effort to produce growth upon injured wood, ultimately to die back. Failing to do this, a year has been lost for many trees. Since the dying-back process has occupied the entire season, the growth that will make the tree has yet to come from the sound roots.

What Killed the Trees—As remarked, many trees put forth a fine growth on trunks and limbs. During the summer by far the greater portion died back. Some said the fermented sap killed this growth; others that the borers did the work. Neither fermented sap nor borer killed the tree; it was sick unto death when the sap fermented, and the borers knew it.

Effects of Cultivation.—Undoubtedly the cultivation of the groves promoted the growth of the the trees; so that it is generally believed that regular cultivation should have been followed. Those who had followed the mulching method also have generally a fine growth. The groves that were neither cultivated nor mulched have not in many instances given a satisfactory show of sprouts.

Stumps That Have Not Sprouted.—On examination of such stumps the roots will still be found to be green. If the earth be removed so as to expose a portion of the live roots, in the coming spring there is no doubt of their sprouting. The orange is a tree that is wonderfully tenacious of life. Like the cat, it will "come back."

Prices.—As to prices for the unequaled Florida orange in the coming years there is but one opinion. The presence of Florida oranges in the market in limited quantities emphasizes the truth that this fruit is wanted, as is shown by a comparison of prices of fruit received from other parts. As production for many years will be far below the demand, prices will no doubt be remunerative for years to come. Those who, therefore, will rebuild their groves have the strongest assurance of a period of prosperity, even surpassing that just closed.

Throughout the tour of the orange-growing country the writer received most courteous attention from all with whom he came in contact. Every facility was given to promote the business in hand. It is fitting in this place to extend thanks for the many favors received, and to give assurance that they were highly appreciated.

THE GREATER AND LESSER FREEZES IN FLORIDA FOR A CENTURY.

[*Read before the Florida State Horticultural Society at the Jacksonville meeting, May 8th, 1895.*]

A retrospect of the climatic conditions which have affected semi-tropical fruits within the last one hundred and twenty-five years cannot fail to possess a peculiar interest just now, when we are passing from under two of the worst freezes which ever occurred in Florida.

The earliest authentic record we have of severe cold weather is in the year 1766, just after the transfer of the Floridas to England.

The night of the 2d January, 1766, John Bartram, the botanist, says "was the fatal night that destroyed the lime, citron and bananna trees in St. Augustine, many curious evergreens up the river that were near twenty years old and in a flourishing state, the young green shoots of the maple, elm and others, with many flowering plants and shrubs never before hurt."

Bartram, who was then camping on the St. Johns River above Volusia, says: "The morning of the 3d was a clear cold morning—thermometer 26 degrees, wind northwest. The ground was froze an inch thick on the banks."

Bernard Romans in his Natural History of Florida (1775) says: "On the 3d of January, 1766, a frost destroyed all the tropical productions in the country except the oranges. The Spaniards called this a judgment on the place for having become the property of heretics, as they never had experienced the like."

In 1774 there was a snow storm which extended over most of Florida. The inhabitants long afterwards spoke of it as an extraordinary *white rain.*

In 1799 the temperature was very low, and on the 6th of April, 1828, a heavy frost was very destructive to vegetation. The temperature at Picolata was as low as 28 degrees. The great freeze, *par excellence*, occurred in 1835, on the 7th of February, when the temperature went as low as 7 degrees above zero. John Lee Williams, writing in 1837, gives the following account of the great freeze of February, 1835:

"A severe northwest wind blew ten days in succession, but more violent for about three days. During this period the mercury was 7° below zero. (This is undoubtedly an error and should read *above* zero instead of *below*.) The St. Johns River was frozen several rods from the shore, and afforded the inhabitants a spectacle as new as it was distressing. All kinds of fruit were killed to the ground. Many of them never started again, even from the roots. The wild groves suffered equally with those cultivated as far south as the 28th°."

He further remarks that in 1837 the wild orange groves south of Volusia and at New Smyrna were in full bearing, which shows that they were not much injured. In 1844 the writer saw very large sweet orange trees on Drayton Island bearing fruit, which could not have been killed down in 1835.

There has been some question as to the exact date of the freeze of 1835. I think there is no doubt that it occured on the night of the 7th and morning of the 8th of February, 1835. Paragraphs in Nile's Register, February, 1835, state that the mercury was one degree above zero at Raleigh, N. C., on the morning of the 8th of February, 1835. That month was excessively cold, the Chesapeake having been frozen so as to close navigation three times during that month. The mercury is reported to have been at 11 degrees above zero at the same period at Fort King, then an army post near the present Ocala.

Dr. Baldwin, of Jacksonville, an excellent authority, informed the Times-Union in 1886, that the date of the freeze of 1835 was the 8th of February, and the mercury stood at 8 degrees above zero, and that about 1850, the day not given, the temperature was down to 16 degrees. In 1857 the mercury fell to 26 degrees at Tampa, 29 at Ft. Pierce, and 30 at Ft. Dallas on the Miami. At Jacksonville the thermometer indicated as follows:

December 28, 1872	27 degrees
January 19, 1873	24 degrees
December 28, 1875	28 degrees
December 3, 1876	24 degrees
December 28, 1878	27 degrees
January 7, 1879	25 degrees
December 30, 1880	19 degrees
January 6, 1884	21 degrees
January 12, 1886	15 degrees
Sorrento, January 12, 1886	19 degrees

With the foregoing statistics before us we are prepared to institute a comparison of the severe freezes we have had in Florida in one hundred and twenty-five years—at Jacksonville as a basing point.

1766—February 3, probably	20 degrees
1835—February 8	8 degrees
1886—January 12	15 degrees
1894—December 29	14 degrees
1895—February 8	14 degrees

In 1766 the effects of the freeze were confined to loss of tropical plants, etc. That of 1835 destroyed all oranges, lemons, etc., north of the 28°. That of 1886 destroyed many young trees and some old trees, but did not affect the crop of fruit in the following year in quantity, though it did in quality. The freezes of 1894-5 appear to have pretty generally killed down lemon trees, grape fruit and young budded stock and many large trees; but, according to present appearance old bearing trees will fruit for part of a crop the coming year. The following table gives the comparative temperature in 1886, 1894 and 1895 at different points in Florida, so far as we have been able to obtain reliable data:

Record of temperature official, and reported, at date of freezes of 1886, 1894 and 1895:

	1886. Jan. 12,	1894. Dec. 29,	1895. Feb. 8,
Jacksonville . .	15 deg.	14 deg.	14 deg.
Lake City . . .	— deg	17 deg.	15 deg.
Tallahassee . . .	— deg.	12 deg.	11 deg.
Pensacola . . .	15 deg.	14 deg.	12 deg.
Fernandina . . .	16 deg.	15 deg.	15 deg.
Green Cove Spri's	— deg.	14 deg.	13 deg.
St. Augustine . .	— deg.	16 deg.	16 deg.
Federal Point . .	— deg.	17 deg.	16 deg.
Palatka	17 deg.	17 deg.	? deg.
Fruitland . . .	16 deg.	16 deg.	. . .
DeLand	17 deg.	16 deg.	17 deg.
Eustis	18 deg.	17 deg.	16 deg.
Citra	— deg.	13 deg.	16 deg.
Archer	— deg.	13 deg.	15 deg.
Volusia	18 deg.	17 deg.	— deg.
New Smyrna . .	— deg.	17 deg.	17 deg.
Oak Hill	— deg.	21 deg.	— deg.
Ocala	18 deg.	19 deg.	16 deg.
Orange City . .	— deg.	18 deg.	18 deg.
Sanford	21 deg.	18 deg.	18 deg.
Orlando	19 deg.	18 deg.	19 deg.
Plant City . . .	— deg.	19 deg.	21 deg.
Kissimmee . . .	— deg.	19 deg.	19 deg.
Brooksville . . .	18 deg.	17 deg.	18 deg.
Tarpon Springs .	— deg.	19 deg.	22 deg.
Titusville	— deg.	18 deg.	19 deg.
Rockledge . . .	— deg.	19 deg.	— deg.

Manatee	— deg.	22 deg.	23 deg.
Avon Park . . .	— deg.	21 deg.	23 deg.
Myers	— deg.	— deg.	30 deg.
Fort Meade . .	— deg.	22 deg.	24 deg.
Jupiter	— deg.	24 deg.	28 deg.
Key West . . .	41 deg.	44 deg.	54 deg.
Minneola	— deg.	20 deg.	— deg.
Leesburg . .	21½ deg.	17½ deg.	16½ deg.
Sumterville . .	— deg.	19 deg.	— deg.
Waldo	— deg.	16 deg.	— deg.
Longwood . . .	— deg.	— deg.	20 deg.
Daytona	— deg.	— deg.	15 deg.
Wildwood . . .	— deg.	— deg.	16 deg.
Bartow	— deg.	— deg.	20 deg.
Palm Beach . .	— deg.	— deg.	30 deg.
Quincy	— deg.	— deg.	7 deg,
Tampa	— deg.	19 deg.	22 deg.
Lake Helen . .	— deg.	20 deg.	16 deg.
Merritt's Island .	— deg.	— deg.	22 deg.
Umatilla	— deg.	— deg.	15 deg.
Tavares	— deg.	— deg.	16 deg.
Ormond	— deg.	— deg.	18 deg.
Welaka	— deg.	16 deg.	— deg.
Melbourne . . .	— deg.	22 deg.	— deg.
Sanford	— deg.	19 deg.	— deg.
Seville	— deg.	19 deg.	— deg.

The conclusion to be drawn from past experience in Florida, is that orange growing in Florida is not any more precarious than agricultural pursuits elsewhere. That but once in one hundred and twenty-five years have all bearing trees been killed to the ground, which was in February. 1835. That the freezes which have produced more or less injury have with two exceptions occurred between the 20th of December and 15th of January, at which season the trees are usually in a dormant condition and well prepared to withstand a very low temperature. The freeze of 1835, sixty years since, did not entirely destroy the trees, and a new growth from the roots came into bearing within six to eight years, while in 1886, the entire crop was in fact larger than the whole crop of that year. Lemon culture has always been regarded as precarious and can only be ventured upon in especially favorable and protected locations north of 28°.

Nursery stock and budded fruit not well matured is, of course, liable to be killed when the temperature goes as low as in the recent freeze.

The fruit on the trees will be hurt by cold, whenever the temperature goes for several hours below 26°, sometimes only partially chilled and rendered lighter, or, as in the recent freeze when the temperature was, at some points as low as 14°, and virtually destroyed, because no large amount of frozen fruits could ever be marketed to any advantage.

After the freeze of December 29th, 1894, the condition of the trees was generally dormant, for from three to four weeks, when sprouts began to appear on all the older trees, and it seemed probable that half a crop might be borne, if they met with no other disaster. By the 7th of February the sap was well up in the trees, grove owners were hopeful and commenced fertilizing and working their groves.

On the night of the 7th of February, just sixty years to a day from the great freeze of 1835, the mercury fell rapidly with very little previous warning, and the trees being leafless, and the sap having generally risen and stimulated new growth, were subjected to as low temperature as on the 29th of December. The effect was not at first perceptible and the younger trees gave for a while some promise of revival, holding their color, but in the course of from four to six weeks, it became apparent that nearly all the lemon, tangerine and grape fruit trees and all trees under ten years of age, had perished to the ground. About April 1st, old bearing trees began to show signs of revival and sprouts put out on the trunks and large limbs a short distance above the bud, and the promise now is that in the central portion of the orange district, new heads will form during the present year, and some fruit be borne in 1896. The young trees are throwing out shoots from the root and will no doubt replace themselves in two or three years on the least injured groves. In the lower portion of the peninsula south of latitude 28° it is thought there will be a crop the present year whieh may amount to 250,000 boxes.

GEO. R. FAIRBANKS,

President Florida Fruit Exchange.

May 8, 1895.

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Bulletin No. 34. March, 1896.

FLORIDA
AGRICULTURAL EXPERIMENT
STATION.

Insect Enemies of Truck and Garden Crops

A. L. QUAINTANCE.

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Florida.

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INSECT ENEMIES OF TRUCK AND GARDEN CROPS.

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INSECT ENEMIES OF TRUCK AND GARDEN CROPS.

GENERAL REMARKS.

The class *Insecta*, or insects as generally understood to-day, includes all those animals having the body segmented, bearing two pairs of legs, usually two pairs of wings, with the body divided into three distinct regions, the head, the thorax, and abdomen. The head bears the eyes, antennæ, and mouth parts; the thorax, the legs, and wings; the abdomen is destitute of appendages.

We may consider the class of insects as divided into two great groups. The first comprises those insects that pass through no metamorphosis; or in other words those insects which in their growth from the egg do not pass through distinct larval and pupal stages, their growth being so gradual that we can not indicate where the larval conditions end, nor where the pupal state begins. Grasshoppers and plant-bugs belong to this group. The young of insects with an incomplete metamorphosis may usually be recognized from their resemblance to the adult insects, from which they differ mainly in the absence of fully developed wings. The immature stage of these insects is known as the *Nymph.*

The second group, which comprises by far the greater number of insects, passes through a metamorphosis, having distinct larval and pupal stages; which usually differ widely the one from the other. Butterflies, beetles, bees, and wasps are members of this group.

We recognize four stages in the life history of insects with a complete metamorphosis, viz: *the egg, the larva, the pupa*, and *the imago*, or *adult.*

Since the greater number of our enemies are members of this group we may now consider these different stages a little more in detail, with special reference to the particular stage at which we can best combat them.

As previously stated, the *egg* is the first stage in the life history of the insect. There is much variation in the size, shape and color of eggs of insects as well as the manner and places in which they are laid. Many insects deposit their eggs in holes in wood, which the female has excavated for that purpose; these eventually develop into the insects known as *borers.* Others deposit their eggs in and on the bodies and eggs of other insects, the larvæ hatching and living at the expense of their hosts, usually ending in their destruction. This class of insects are known as *parasites,* and do untold good by thus preying upon the injurious ones, keeping them greatly reduced. The eggs of the insects with which we are most concerned, however, are usually laid on the various plants which are to furnish food for the insect in its next or larval stage. The eggs of many of these insects are large enough to be detected and destroyed, many species laying them in large patches on the under or upper sides of leaves. The eggs of most insects destructive to garden crops can be destroyed by spraying them with kerosene emulsion, and we should strive to kill as many as possible of our pests in this early stage of their existence. Many insects winter in the egg state, hatching with the advent of warm weather. These eggs are usually laid in sheltered and protected places, in fence corners and among the weeds and grass. From this it is seen that we can do much to prevent the abundance of these insects by keeping the fields and gardens thoroughly cleaned, thereby removing suitable places in which the insects may deposit their eggs.

The second stage of the insect is known as the *larval* stage. Larvæ of the orders of Beetles, Flies, and Butterflies are known respectively as *Grubs, Maggots, and Caterpillars.* The Cabbage Worm is the larva of a butterfly; the larva of the house fly is a maggot, while the *Grubs* that are so frequently overturned in digging and plowing are larvæ of beetles. It is in this state that insects perhaps do the most harm, as this is the period in which they feed and grow, laying up nourishment for their final transformation. It is also in this second stage that we can do most to control these insects, and all pains should be taken that they are destroyed before they have passed through the pupa and into the adult condition, when they become endowed with much better powers of locomotion, and deposit their eggs here and there on our crops.

The third stage, known as the *pupa,* is usually a resting state, a state of inactivity, in which the larva transforms into the perfect insect. Larvæ lay up sufficient nourishment while in that condition to enable them to continue their growth while they are in the usually quiescent, and seemingly lifeless *pupa.* Not many insects are injurious in this stage. Many pass the winter in this condition, in sheltered and out-of-the-way places, where the instincts of the larvæ have led them to crawl. We can do much to destroy the insects in this stage by burning all rubbish heaps, leaves, and other trash in the field in the fall, thus removing places of protection and destroying the *pupa* which would pass the winter in them.

The *imago,* or adult stage, terminates the development of the insect. This stage is represented by our beetles, moths, flies, and butterflies. The time required for different insects to arrive at this condition varies greatly. Some may go through their entire life history in three or four weeks, others may require several years to complete their growth. Upon arriving at maturity, however, the eggs are deposited from which new broods are to develop. As a usual thing the eggs are laid on the plant that is to furnish the larvae with food. Knowing this, we can frequently destroy them as previously suggested. Beetles, plant-bugs and grasshoppers are, as adults, besides laying eggs, quite destructive to our garden crops, eating the foliage or sucking the sap from the plants. The moths, butterflies and flies are not in themselves injurious, save in the harm that they bring about in the laying of their eggs; but in view of this, we must take means to destroy them and prevent the depositing of eggs. We can do much to destroy the adult injurious insects by the use of the various insecticides, and also prevent the less injurious ones from depositing their eggs, by the use of repellants.

It now becomes important that we should know something of the remedies which are to be applied, and certain fundamental differences in the structure and manner of procuring food of the insects to be treated.

So far as our present purposes require we may consider only those vegetable-eating insects which can be divided into two groups, namely, (1) those which obtain their food by piercing the stems and leaves of plants with their stout beaks, and sucking up their juices; and (2) those whose mouth parts are adapted for biting and which obtain their food by eating and gnawing the various parts of plants. These two different groups of insects evidently require different methods of treatment.

To the first group, or sucking insects, belong the plant lice, leaf-hoppers, true bugs, and others. These cannot be killed by the use of the various arsenical insecticides, since they do not eat of the poisoned foliage, but obtain their food from the unpoisoned interior of the plant.

These insects we must kill by applying some external poison, either in the way of an irritant or something that will stop up the breathing pores, or tracheæ. Our kerosene emulsions, whale oil soaps, and resin washes, are remedies of this kind, and are to be used in combatting this class of insects.

Our second class, or biting insects, are represented by the locusts, or grasshoppers, cabbage worms, and beetles. These are killed by eating the foliage which has been poisoned by the use of arsenites or other poisons.

Another way in which we may kill both of these classes of insects is in the use of substances which will poison the air that they breathe. This is best done by the use of carbon bi-sulphide, sulphur spray, hydrocyanic acid gas, and pyrethrum.*

SPRAYING MACHINES.

The use of some form of spraying apparatus is almost indispensable in combatting the various insects that attack the crops of the farm and garden. It has been will said that a spraying machine is as much a necessity on the farm as a plow. It is sometimes a great advantage to have two machines, one for applying liquids, and the other for applying powder. But where it is not possible to have these two forms of machines, it would be best to secure some form of force pump, with spray noz-

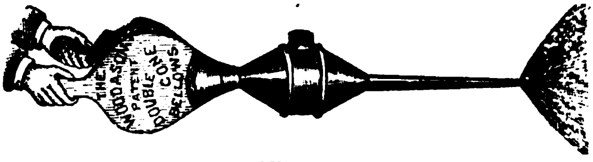

Fig. 1.

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*For information concerning the preparation and use of the various insecticides and fungicides, see Bulletin Number 23, of this station, by Prof. P. H. Rolfs, on "Insecticides and Fungicides" zles. The powder can thus be applied thoroughly mixed with water.

In order to facilitate the selection and purchase of a spraying machine, some of the more important forms are here illustrated, with the address of the manufacturer, or dealer, and the prices at which they may be obtained.

Figure 1, illustrates an excellent form of hand bellows to distribute insecticides in the form of powder. For use in hot houses, and small gardens they will be very efficient.

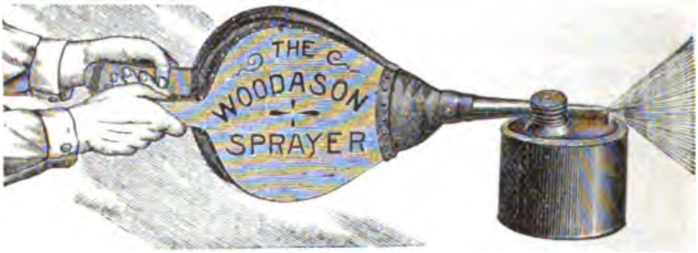
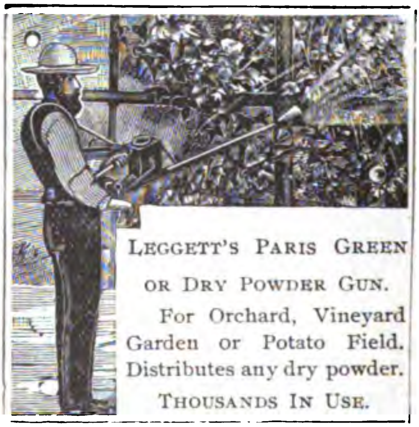


Fig. 2.



LEGGETT'S PARIS GREEN
OR DRY POWDER GUN.
For Orchard, Vineyard
Garden or Potato Field.
Distributes any dry powder.
THOUSANDS IN USE.

Fig. 3.

These bellows may be purchased of the manufacturer, Mr. Thos. Woodason, 2900 D Street, Philadelphia, Pa. Price, $3.

In figure 2 is shown another of Woodason's Hand Bellows. This bellows is for the distribution of liquid insecticides. Price, $2.

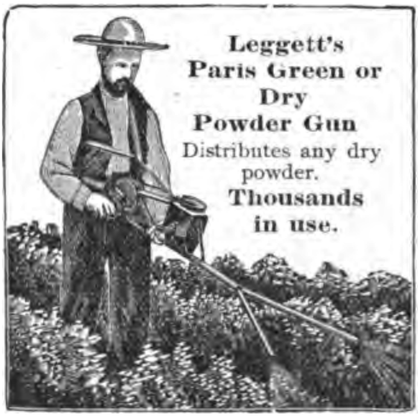


Fig. 4.

Leggett Bros., 301 Pearl street, New York, are manufacturers of a valuable powder gun for the application of powder on a large scale. In figures 3 and 4 the gun is illustrated as in use.

The machine is made of iron, tin, steel, and brass, and weighs about five pounds. As shown in the figures, it is attached to the body by two straps, the powder being distributed by turning the crank. Tubes, and different forms of funnels are made to use with the gun to best suit it to the plant treated. The gun may be purchased of the manufacturer for $7.50. They may also be obtained of Messrs. Howard & Kennedy, Terra Ceia, Fla., and of Painter & Co., Deland, Florida.

Figure 5 illustrates the Excelsior Spraying Outfit, No. 19, as manufactured by William Stahl, Quincy, Ill. The outfit consists of a brass valved pump, hose and nozzle. These are quite servicable bucket pumps and will be quite sufficient for small gardens.

Mr. Stahl is also manufacturer of an Excelsior Clock Pump, which can be mounted on a barrel, and is quite desirable where it is necessary to use large quantities of insecticides. It consists of force pump, hose and nozzle, with a second hose extending down into the barrel, which serves to keep the contents well stirred, thus securing an even distribution of the insecticide.

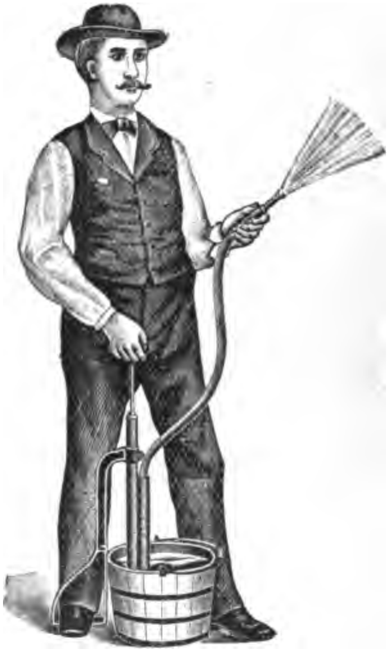


Fig. 5.

The Empire King Spraying Pump, shown in figure 6, is for sale by the Field Force Pump Co., Lockport, N. Y. The pump is well suited to spraying on a large scale, being provided with two hose and spraying nozzles, by which spraying from each side of the wagon may be carried on at the same time. When desired one hose may be shut off. Either the Eureka or Vermorel nozzle may be used. Price complete, without barrel, $12.50.

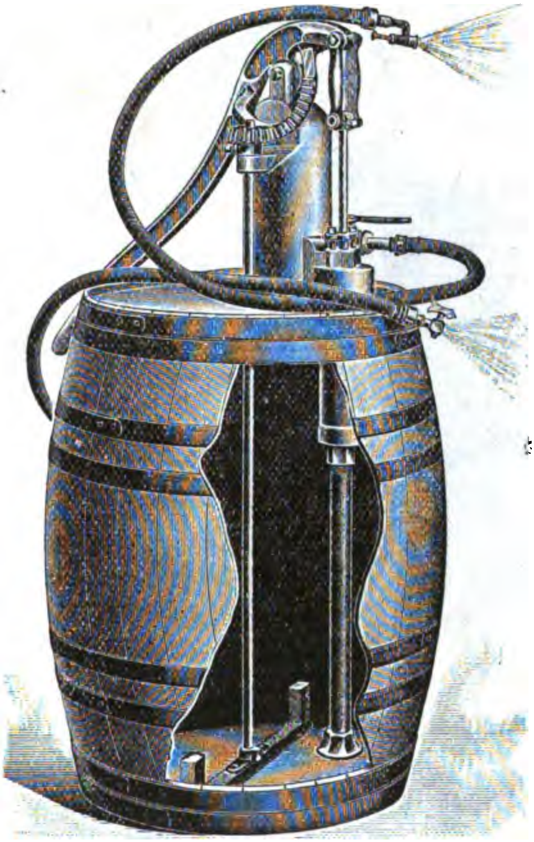


Fig. 6.

The Field Force Pump Company are also manufacturers of a Truck and Barrel Sprayer, shown in figure 7, intended for use in gardens and orchards, where it is not practicable to drive a horse. It can be purchased complete, as shown in the cut, for $19.00.

Knapsack Sprayers have quite deservedly come into general use in the treatment of fungous and insect enemies of the vineyard and garden. They may be strapped on the back, the pumping being done with one hand,

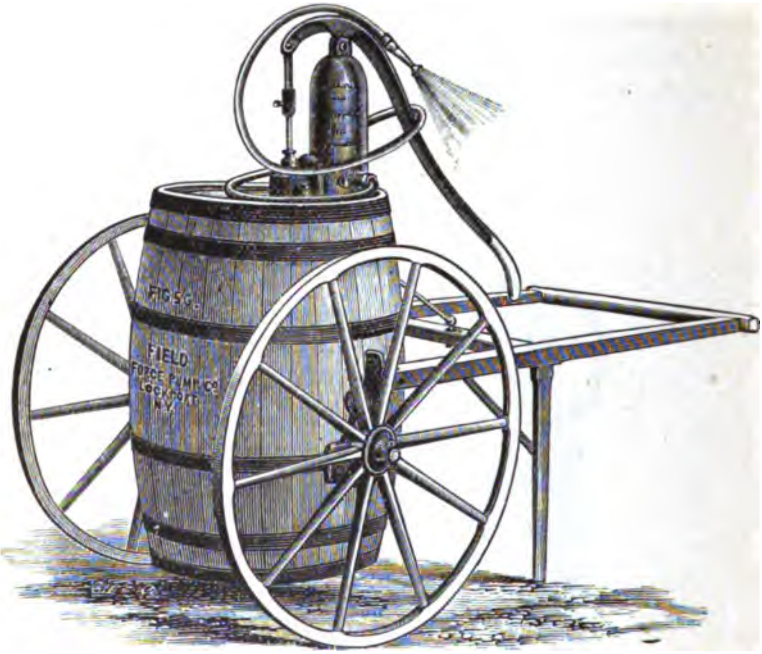


Fig. 7.

while the hose is held with the other. With this form of sprayer the liquid may be applied very thoroughly.

W. B. Douglass, Middleton, Conn., is manufacturer of a Knapsack Sprayer with Kerosene Attachment, shown in the figure. Experiments have been made in which kerosene, thoroughly mixed with water, was effectually used against insects, instead of the emulsion, and producing no harmful results to the plants.

With this Sprayer this mixing of the kerosene and water is accomplished while in the act of spraying. The advantages of using kerosene in this form over its use in the form of an emulsion are at once apparent; however, in the use of this form of sprayer, certain precautions should be observed. See that the kerosene and water in

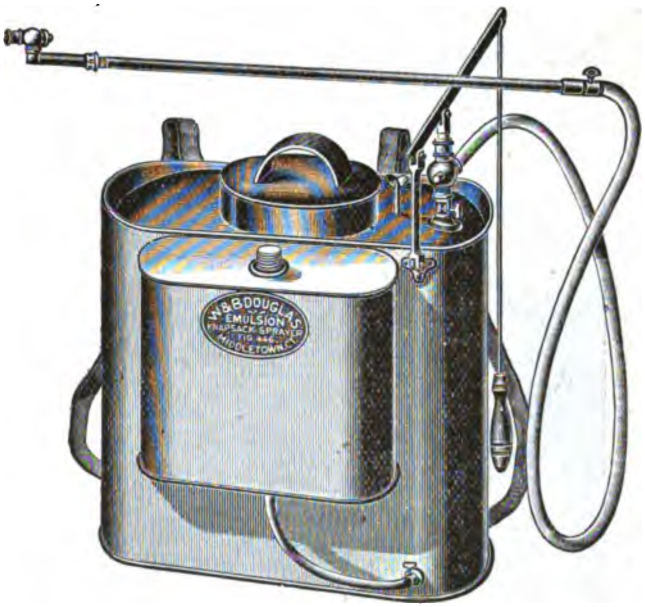


Fig. 8.

their respective tanks are always kept at about the same level with each other. An inequality of level of either of the liquids may cause a disproportionate mixing, which, in case the kerosene is in excess, might prove to be injurious to the foliage upon which it was sprayed; or in the other extreme, would not be strong enough to destroy the insects.

The Kerosene Attachment may be readily removed when it is desired to use the sprayer for other insecticides or fungicides.

Price complete, as shown in figure 7, with copper tanks, $20.00. Liberal discounts may be obtained by writing the manufacturers. The Sprayers may also be purchased of the company in New Orleans, 431 Gravier street, and in New York city, 85 and 87 John street.

MCGOWEN INJECTOR.

The McGowen Injector, shown as in use in figure 9, is an invention of Mr McGowen, of Ithaca, N. Y. This is an instrument for the application of insecticides against insects living in the ground and attacking the under ground portions of plants. With this injector, charges of carbon bi-sulphide may be left in the ground near the roots of the infested plants, the disseminating vapors of which will, in most cases, quite effectually destroy the insects.

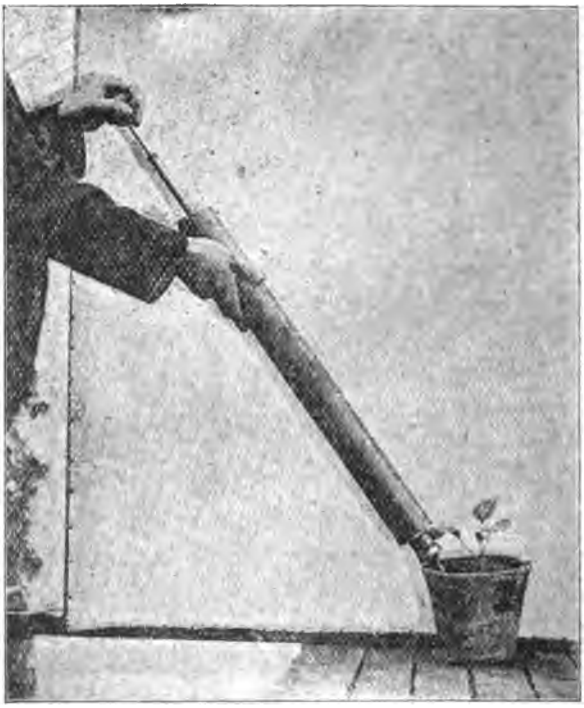


Fig. 9.

All parts of the injector are of brass or tin, except the leather in the valves, which can be easily removed and replaced with new ones when necessary. The injector may be made with reservoirs of varying sizes, and of tin or brass. A reservoir holding about two quarts would be large enough to treat about five hundred plants, allowing one teaspoonful to the plant. Mr. McGowen will make them of any size desired. An injector weighing about eight pounds, when filled with the liquid, will be a very good size. Such an instrument will cost from three to five dollars, depending upon the material used. In using the injector the following directions should be followed:

Fill the reservoir, with the handle pressed down, by pouring in the liquid at the top. In inserting the injector, the hole should begin about three or four inches from the plant. Push the injector obliquely downwards until the point is under, and a little below the roots. The load is here discharged by pulling up the piston rod, which act also reloads the chamber. Pull out the injector and close the hole by pressing the earth with the foot. In every case, before inserting the injector, see that the piston rod is pushed down. This will prevent dirt from getting into the lower end, which will be quite hard to remove.

INSECTS AFFECTING THE BEAN.

CUT-WORMS.

(*Larvæ of the Noctuid family of moths.*)

Just as the beans are sprouting through the surface of the ground they are frequently greatly injured by the depredations of the so-called "cut-worms". These insects pass the day in the ground, or under old boards, brush, or other places of refuge, and at night come out and feed on the tender seedlings of the bean, or other garden plants. They may attack the bean in different ways. Just as the young plant is pushing its way through the soil, it may be eaten off close down to the ground. Later, when the plant has grown more, and the seed leaves have been pushed up into the air, the soft herbaceous stem may be attacked and badly eaten into, so that it will wilt, or droop over. Or, the worms may climb up the stem, and eat or cut off the seed leaves and plumule. Cut-worms are the larval forms of certain night flying moths, belonging principally to the genera *Agrotis*, *Mamestra*, and *Hadena*. They are quite generally distributed throughout the United States.

DESCRIPTION.

The Eggs.—The eggs are quite small, about the size of fine dust shot, varying somewhat in color and markings in the different species. See figure 10—a, much enlarged; b, natural size.

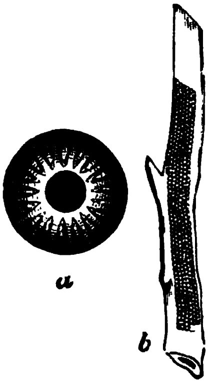


Fig. 10.—*Agrotis saucia:* Eggs, a, single egg greatly enlarged; b, egg mass on twig, natural size.

The Larva.—The cut-worms may be recognized by their cylindrical, naked, somewhat tapering fleshy body.

The segment next to the head is provided with a distinct horny scale; the body is usually marked with longitudinal stripes which, however, are not always present; their presence or absence usually serving to harmonize their color with that of the ground, or the plants upon which

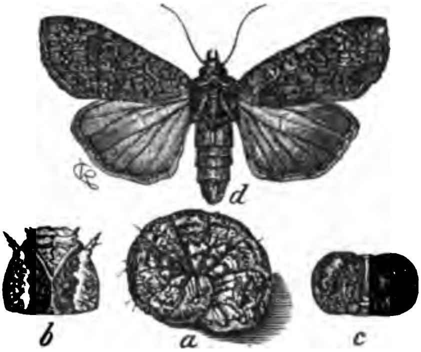


Fig. 11.—*Agrotis saucia:* a, larva; d, adult.

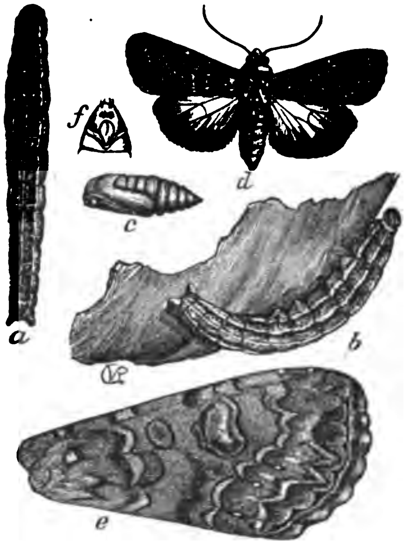


Fig. 12.—*Mamestra chenopodii:* a, b, larva; c, pupa; d, moth; e, wing of moth, enlarged.

they feed, thus protecting them somewhat from detection. When disturbed, these worms have the habit of curling themselves up, and remaining motionless for a time. See figure 11, a and b, and figure 12, a.

The Adult.—The moths (see figure 11, d, and figure 12, d) of the various species of cut-worms are rather small, having a wing expanse of about one and one-half inches, and are usually of a uniform ashy or brownish color. On each fore-wing is usually to be found a kidney-shaped spot of lighter color than that of the surrounding parts. When at rest the wings are laid back roof-shaped over the body, causing it to appear much smaller when still, than when flying.

LIFE HISTORY.

The eggs are laid by the female moth during the late spring, or early summer, on the leaves and stems of low bushes or grass. As soon as these hatch, the larvæ descend to the earth and feed upon the tender portions of herbaceous plants. At this time the larvae are quite small and are easily overlooked. At the approach of winter they crawl under old boards and rubbish, or else burrow into the ground and there pass the winter in the larval condition. At the coming of spring they leave these places of retreat and begin their search for food. They are hearty, voracious feeders, and attack many kinds of vegetables, eating them as they appear above the surface of the ground. Soon they have attained their full size, and burrow into the earth just below the surface, and there transform into pupae, and a few weeks later emerge as moths which soon deposit eggs again.

TREATMENT.

According to Dr. Riley, one of the best ways to destroy cut-worms is to place poisoned cabbage, or other leaves, around over the field a week or ten days before planting. The leaves are poisoned by dipping them in a water solution of Paris green or London purple. They should be renewed every three or four days. These poisoned leaves serve as a bait to the larvae, and many are thus killed. The use of these baits may be continued after the crop has been planted, by placing them between the rows. In the use of these baits care should be taken that they are not eaten by stock.

Another good form of bait is made by mixing bran and Paris green, in the proportion of one quart of bran to one teaspoonful of Paris green. This can be distributed promiscuously throughout the field.

Another effective way of reducing their number is to make a vertical hole in the ground near the plants about a foot deep, by the use of a sharpened broom stick. The worms upon the approach of light, crawling away to hide will enter these pits and be unable to crawl out again. Boards might be placed around in the field between the rows of vegetables, and frequently examined. The worms hiding beneath these should be killed. Birds and barnyard fowls destroy great numbers of these cut-worms in their early morning search for food, and should be encouraged.

Cut-worms are quite general feeders, scarcely any variety of garden vegetables being free from their ravages. Some species of cut-worms are known to even climb trees, and do much harm by eating the tender buds.

WIRE-WORMS.

"Wire-worms" (larvae of Elaterid beetles), are at times reported as damaging the bean crop by eating the seed immediately after planting, or before it has grown into a plant with rootlets capable of obtaining food from the soil.

The young plants show signs of attack by slow and improper growth, wilting, and perhaps eventually dying. The attack on the seeds can not, of course, be detected.

The family of Elaterid beetles is a large one, more than five hundred species being found in North America alone.

DESCRIPTION.

The Larva.—Wire-worms are long, narrow, hard, cylindrical worms, of a brownish white color, the body tapering gradually to each end. The body is quite distinctly segmented, its general appearance and hardness suggesting the name by which they are known. Figure 11, a.

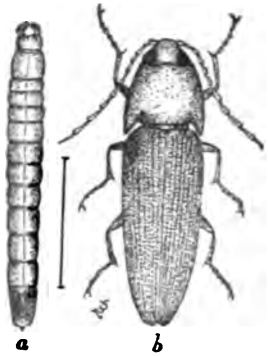


Fig. 13.—*Melanotus communis:* a larva; b, adult.

The Adult.—The mature or adult stage of the wire-worm is our common snapping or "click" beetle, with which all are probably quite familiar. Our most common click beetles are rather small, ranging from one-fourth to one inch in length, are usually of an even brownish color, or, as in some, variously marked and spotted. All may be easily recognized by the loose articulation of the fore to the hind-body, allowing the insect to snap, springing several inches in the air. See figure 13, b.

LIFE HISTORY.

The eggs are probably laid in the spring, in undisturbed places in the field, as in the fence corners, in and around old log heaps and brush piles. The eggs soon hatch into wire-worms, in which state they may remain in some species, as long as three years before maturing, living in the soil and depredating the seeds and roots of plants. The larvae finally change to pupae, however, usually in the early fall, and soon change to beetles; these remain in the ground until the following spring when they appear and deposit their eggs.

TREATMENT.

Owing to the underground habits of the wire-worms they are quite diffcult to combat successfully. Preventive measures will do much to lessen the injuries done by these insects. Late fall plowing of badly infested land will destroy a great many, by breaking open their resting cases. The fields and gardens should be kept free from decayed wood, logs and brush heaps, thus lessening the favorable places for deposition of eggs.

Other plants affected by wire-worms are corn, peas, melons, squashes. and other garden crops.

THE BEAN WEEVIL.

(*Bruchus obtectus,* Say.)

This familiar insect is perhaps one of the most serious pests affecting the bean. The damage done is much more apparent in the seed beans,. which are some times nearly destroyed by its ravages, but the yield and marketable value of the bean are greatly lessened by the work of the larvae within the young and growing bean.

Bean pods infested with this insect show warty protuberances, terminating in black specks, marking the entrance of the larvae. By many, such pods are thought to have been stung, and are called "specked" beans. Beans so affected do not find a ready sale on the market.

The effects of these insects should not be confounded with that of a fungous disease, also affecting the bean pod. They are easily distinguishd, however, as the fungus produces depressed reddish spots on the pod, about one-third of an inch in diameter, which gradually grow into enlarged circular spots. Beans affected with this fungus (*Colletrotrichum*) are said to be "spotted".

The bean weevil was probably introduced into this country, and is now quite generally distributed, being found over a large portion of the United States. It is particularly abundant in the Southern States. As early as 1860 it was noticed that this beetle was attacking the bean, and in later years as the growing of this plant increased, it has shown decided partiality to this crop, which now furnishes the greater part, if not all of its food.

DESCRIPTION.

The Larva.—The larva is a small, soft-bodied, grub-like insect, passing its entire life in the bean.

The Adult.—The beetle is about one-tenth of an inch in length, ashy black, with a slight brownish tinge. The body is quite hard, and is somewhat flattened.

LIFE HISTORY.

The adult beetle lays her eggs in the young and tender pod, by gnawing a hole and then depositing the eggs within. The eggs hatch within eight or ten days, and the larvæ, penetrating the bean, begin to feed. Several larvæ may inhabit the same bean, in which case, each has its separate cavity. The larvæ reach maturity in the latter part of the summer and transform into pupæ in the fall. It is not known with certainty how long they remain in the pupa state, but sooner or later the been weevil appears, and again deposits eggs on the young beans; or, in the case of stored beans for seed or other purposes, on the dry beans. Many successive generations may be raised in stored beans.

TREATMENT.

Beans saved for seed or other purposes should, upon being brought in, be thoroughly subjected to the fumes of carbon bi-sulphide. This is very easily done in the following way: Secure a tight barrel, cover the bottom with a layer of the shelled beans about six inches deep, pour over this layer an ounce of carbon bi-sulphide. Place over this another layer of beans of the same depth, and treat with the liquid as above, and so on until the barrel is full. It should then be covered over as tightly as possible and left for two or three days for the fumes to do their deadly work. It should never be forgotten that carbon bi-sulpuide is highly inflammable. In its use no fire of any kind, a lighted cigar, pipe, or lantern should be brought near it. A thorough application of this kind will in all cases prove an efficient and practicable remedy, not only against the bean weevil, but against the corn and other weevils. The cheapness of the remedy and the readiness of application, strongly recommend it to general use.*

THE RED-LEGGED LOCUST.

(*Caloptenus femur-rubrum*, Burm.)

Various species of grasshoppers or locusts (See figures 14, and 15) are at times destructive to beans and other garden and truck crops, eating the tender shoots and pods.

The Red-legged Locust (*Caloptenus femur-rubrum*) is usually the most serious offender, and will be the species here referred to. The suggestions for treatment, however, will apply quite as well to the other species of the locust family as to this one, their manner of feeding being quite alike.

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*See Bulletin 23, page 27, of this Station for a more complete discussion of carbon bi-sulphide, and where it may be obtained.

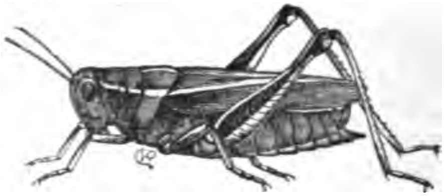

Fig. 14.—*Caloptenus bivittatus:* adult.

The Red-legged Locust is quite generally distributed over the United States, being by far the most abundant species, except in certain high and dry sections of our country, where it is replaced by a nearly allied species.

DESCRIPTION.

The Nymph.—The young locust is a mottled, brownish olive insect, without perfectly developed wings. It bears a close resemblance to the adult, and may be more easily recognized by reading the description for the mature form.

The Adult.—The full grown Red-legged Locust measures from three-fourths to one inch in length, with a wing expanse of one and one-fourth inches. The general color of the insect is a dirty olive and brown. A black streak extends from the eyes along the sides of the thorax. Along the middle of the wing-covers is a row of

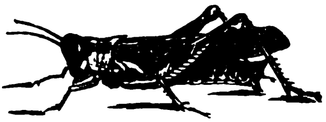

Fig. 15.—*Caloptenus femur-rubrum:* adult.

dusky brown spots. The wings are transparent, netted with brown veins. The hindmost shanks are blood red, with black spines. On the hindmost thighs are two large spots on the upper side, with the extremity black. On the inside they are yellow. See figure 15.

LIFE HISTORY.

The eggs are laid in the ground in cocoon-shaped masses. The female bores a hole in the earth with her ovipositor, and there deposits her eggs, covering them over with a tough cementing substance. These hatch into wingless little locusts, which, eating the tender portions of various plants, do considerable damage, even at this early stage. After the first moult the wings begin to develop, which, after two more moultings, have become fully grown, and ready for use of the now fully matured insect. Unlike the cut-worms, the locusts pass through no resting stage, but continue their depredations uninterruptedly throughout their whole life.

TREATMENT.

The best remedy against locusts and like insects is probably to be found in the use of poisoned bran, sweetened with syrup or molasses. Prof. Davis, of the Michigan Agricultural Experiment Station, has found that locusts eating of sweetened bran to which has been added sufficient Paris green to give it a greenish tinge, died within twenty-four hours. The poisoned bran may be placed around promiscuously in the field, care being taken that it is not accessible to fowls or stock.

OTHER INSECTS AFFECTING THE BEAN.

Among other insects affecting the bean are to be mentioned the Flea-Beetles, small, black, jumping insects, eating holes in the leaves. These will be considsered later, under the head of cabbage, to which plant they seem to show a greater partiality. The Boll-Worm of the cotton (*Heloithis armigera*) is sometimes found eating the pod of the bean. This insect will be considered as affecting the tomato, to which refer for further information regarding it.

INSECTS AFFECTING THE BEET.

The beet plant affords food for many species of insects. We will consider here only the more common and important ones.

THE BLISTER-BEETLE.

(*Epicauta vittata*, Fabr.)

The Striped Blister-Beetle, or "Old Fashioned Potato Bug," is frequently a serious pest, eating the leaves of the beet plant, as well as those of many other garden vegetables. These beetles are rather gregarious, feeding in large groups. They eat the soft parenchyma of the leaves, leaving the plants quite destitue of healthy foliage.

DESCRIPTION.

The Larva.—The larva is an active little creature, running around on the ground, feeding on the eggs of other insects, principally those of the locust.

The Adult.—The beetle may be recognized by its rather soft body of a yellowish color above, with two black stripes extending longitudinally down its wing-covers. The body and legs beneath are black. This insect is about one-half inch in length. (See fig. 16.)

LIFE HISTORY.

The eggs are laid during late summer or early fall, in masses in holes in the ground which the female has excavated. As the larvæ depend somewhat upon the eggs of the locust for their food, the female usually selects a place for depositing her eggs that abounds with the egg capsules of those insects. The eggs hatch in the course of eight or ten days; the larvae, feeding on the locust eggs, attain their growth, and construct for themselves a cell in the ground and finally assume the pupa state. From this state they appear, under normal conditions, in the course of a week or two, as adult blister-beetles, and begin their depredations on the vegetable crops.

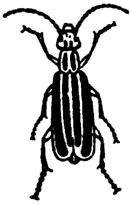

Fig. 16.—*Epicauta vittata:* adult.

TREATMENT.

Fortunately but one brood is raised each year. Hand-picking and destroying is a very effective way of getting rid of them. Paris green or London purple may be used, either as a spray or in the form of powder.

CUT-WORMS.

The various species of cut-worms referred to as affecting the bean, also damage the beet. The same treatment is to be employed.

WIRE-WORMS.

Not unfrequently beets are attacked by the wire-worms referred to as affecting the bean. They injure the beet by eating the fine fibrous rootlets, and boring and eating into the root. This is particularly the case when the beets have been planted in land that is new, or that has been left uncultivated for several years, and has grown up to grass. Their ravages may be greatly mitigated by observing the precautions previously referred to.

OTHER INSECTS AFFECTING THE BEET.

Other insects affecting the beet are the leaf hoppers, bugs, and plant-lice, all injuring the plants by piercing the stems and leaves and sucking the juice. When these become very troublesome they can be kept in check by spraying with kerosene emulsion.

INSECTS AFFECTING THE CABBAGE

The list of insects affecting the cabbage in this State is quite large, and their ravages are proportionately severe.

FLEA-BEETLE.

(*Phyllotreta vittata*, Fabr.)

Much injury is done to the cabbage while yet in the seed bed by these small insects. Eating innumerable small pits in the surface of the leaf, rarely eating a hole through the leaf, except in the more tender and thinner portions, they greatly interfere with the proper growth of the plant. Their minute size is well made up for by their abundance and surprising agility.

The attack of these insects should not be confused with the attack of a fungus known as "damping off". This fungus causes the stems to shrivel up near the soil, causing the plant to fall over.

DESCRIPTION.

The Eggs.—The eggs are laid in groups of two or three near the ground on the stems or roots of cruciferous plants, the females gnawing an irregular cavity in which they are deposited.

The Larva.—The larva is about one-third of an inch in length, small, yellowish, almost cylindrical, with the head of a darker color, living underground, feeding upon the roots of plants, and frequently doing much damage in this way. See figure 17, a, much enlarged.

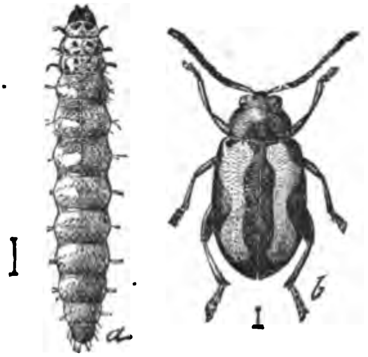

Fig. 17.—***Phyllotreta vittata:*** **a, larva; b, adult; much enlarged; hair line represents natural length.**

The Adult.—The Flea-Beetle is about one-tenth of an inch in length, oval in shape and glossy black, except on the wing covers, which are each marked with a wavy streak of pale yellow. Its posterior legs are strong and well fitted for jumping, as the name suggests. Figure 17, b.

LIFE HISTORY.

The larvae, after attaining their proper growth, transform into pupae in earthen cocoons. About seventeen days later the beetles appear, and begin feeding upon the tender leaves of the young cabbage. The summer broods are sometimes very injurious in their larval state to the roots of the cabbage, causing the plants to wither and die.

TREATMENT.

Dusting the plants with lime, ashes, or refuse tobacco will generally keep the beetles from attacking them. A decoction of tobacco water made by boiling or soaking tobacco leaves in water is a good preventive. Kerosene emulsion should be sprayed around the roots and stems to destroy the eggs and young larvae.

HARLEQUIN CABBAGE BUG, OR CALICO BACK.

(*Murgantia histrionica,* Hohn.)

This insect is one of our worst enemies to the cabbage in the South. The bugs injure the cabbage by puncturing the plant and sucking its juices. Their effects are quite disastrous, causing the plant to wither, and not mature. The combined attack of a half-dozen insects may kill a plant in one day.

The "Calico Back" was first noticed in Texas in 1866, and hence is thought to be a native of that State, or of Mexico. It is now quite a common pest throughout our country.

DESCRIPTION.

The Eggs.—The eggs of the Calico Back are quite pretty, much resembling minature barrels. At first they are green in color but soon become white with black markings, much resembling the hoop to a barrel; a small black spot on the side indicates the bung-hole. The eggs are deposited on the underside of the leaves, usually in two rows. Figure 18, c, natural size; d, enlarged.

The Nymph.—The young bug is at first of a yellowish color; it is of an oval form and somewhat flattened. The antennæ, now, are only four-jointed, but in the adult are composed of five joints. As the insect develops, wings begin to grow out, and the body becomes marked with reddish yellow. Figure 18, a and b.

The Adult.—The adult Harlequin Cabbage Bug may be recognized by the gay harlequin arrangement of the black and orange colors on its body. It measures about two-fifths of an inch in length, and somewhat less in breadth. It is of an oval form, and is very much flattened. Figure 18, f and g.

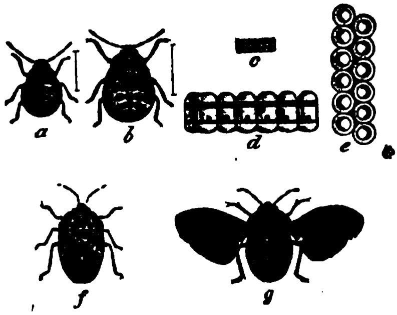

Fig. 18.—*Murgantia histrionica:* a and b, nymph; e and d, eggs, natural size and enlarged; f and g, adult.

LIFE HISTORY.

The eggs are said to hatch within three or four days after being laid, and the young to grow and be able to reproduce themselves in two weeks. The first laying of eggs is usually deposited on the mustard, turnip, or radish plant; the nymphs from these muturing about the time the cabbage is heading, attack it and rear their broods upon it.

In the northern and colder portion of our State many of the adults at the approach of winter seek protection by hiding under rubbish, logs, and brush, or almost anything that will afford them protection.

Over a considerable area of Florida, however, the weather does not become sufficiently cold to drive the insects to shelter, and they may be found at almost any time during the winter months feeding upon cabbage and rutabaga plants.

TREATMENT.

These insects are particularly difficult to combat; the ordinary arsenic poisons have no effect upon them, as they take their food by sucking and not by biting. The best treatment of this pest is probably to be found in destoying them in the winter and early spring. During the winter they are greatly reduced in numbers, and can be almost exterminated by a vigorous and persistent attack. The insects wintering on the cabbage and other plants should be destroyed by the use of kerosene emulsion, or by picking them off by hand. In the northern part of our State where the insects hibernate, the fields should be thoroughly cleaned of all rubbish in the fall, that would furnish them places of retreat. The first insects appearing in the spring should be destoyed thus lessening the parents for the future offspring. This is best done by planting mustard, radish, or rutabaga plants early in the spring, to serve as catch plants; the bugs congregating here can be destroyed by hand-picking or spraying with strong kerosene emulsion. The cabbage plants should be carefully watched, and upon the first appearance of the pest they should be destroyed by hand-picking.

The time of warfare should be in early spring: much can be done at this time with little trouble compared to that which must be given later if neglected.

THE CABBAGE PLANT-LOUSE.

(*Aphis brassicæ*, Linn.)

The Cabbage Aphis was imported to this country from Europe something over a hundred years ago. It has now become quite widely disseminated throughout the United States.

As a general thing they are not sufficiently abundant to attract attention, but sometimes under favorable conditions they may become so numerous as to do considerable damage. They injure the cabbage and other plants by piercing the epidermis with their beaks and sucking up the juices, greatly reducing the vitality of the plant. When exceedingly numerous they may cause the plant to wither and die.

DESCRIPTION.

The Nymph.—The young Cabbage Plant-Louse, is quite small, considerably less than one-tenth of an inch in length; it is oval in shape, of a pale green color which is more or less obscured by a dusting of grayish powder. The legs and antennæ are black.

The Adult Wingless Female.—The wingless viviparous female, differs from the young in being larger, more plump, and unwieldy. Protruding from the caudal portion of the back of the abdomen is a pair of short black "honey-tubes" which secrete a fluid, the "honey-dew". Figure 19, b, much enlarged.

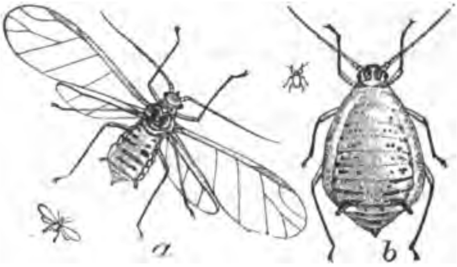

Fig. 19.—***Aphis brassicae:*** **a, winged viviparous female; b, wingless viviparous female; much enlarged; natural size indicated by small figures.**

Winged Viviparous Female.—The winged viviparous plant-louse differs most noticeably from the wingless form in the possession of wings. When at rest these are held back roof-like over the body, extending far beyond the abdomen. The general color is yellowish green with the eyes and head black. The legs are brown, and hairy. The honey-tubes are dark brown. See figure 19 a.

Besides these forms, there are the wingless oviparous female, and the winged male.

LIFE HISTORY.

During the warmer portions of the year, the winged and wingless viviparous females only, are usually to be found, bringing forth their young alive. The fecundity of these insects is quite remarkable; a single plant-louse may become the mother of millions of children and grand-children during a season. Upon the approach of cold weather, or the decrease of food supply, true males and females are produced and winter eggs are laid which hatch the next spring into the winged and wingless viviparous females. In our State it often happens that the food supply and mildness of the weather allow the louse to pass the winter without the production of males and females, and winter eggs. Plant-lice have been kept in confinement under favorable conditions for several seasons without the intervention of the winter eggs. It thus seems that these are necessary, only when conditions are adverse to the life of the viviparous forms.

Plant-lice have many parasitic enemies which serve greatly to keep them in check.

TREATMENT.

The Cabbage Plant-Louse may be quite successfully treated. Pyrethrum powder mixed in its proper proportions with water, applied as a spray, with a Knapsack Sprayer will be found to be quite effective. Kerosene emulsion, if properly diluted to about one-half strength and applied as above, will probably give satisfactory results. In the use of this emulsion on cabbage, care must be exercised to have it sufficiently diluted so that it will not blister the plant. Experience must here be the guide; begin with a weak solution, and note its effect The lice will usually all be killed with a solution that is sufficiently weak to have no injurious effect on the foliage. Whale-oil soap and tobacco decoction are also valuable.

THE IMPORTED CABBAGE WORM.

(*Pieris rapæ*, Linn.)

The Rape Butterfly was imported from Europe about 1856. It probably made its arrival in this country with a shipment of vegetables from England to Quebec. Since its arrival, it has spread rapidly southward and westward, until now in most localities it has quite supplanted our native species *Pieris protodice.* According to Dr. J. C. Neal, this butterfly first made its appearance in Florida in 1890. It is now becoming quite common. The worms or larvae, feed upon the cabbage leaves quite riddling them with holes.

DESCRIPTION.

The Eggs.—The eggs are quite small and when first laid are white, but soon become of a yellowish color. They are usually laid singly, on the under sides of the leaves.

The Larva.—The cabbage worm, full grown, is about one and one-fourth inches in length, greenish in color, with a yellowish line extending down the back, and with small yellow spots along each side. (Figure 20, a.)

The Pupa.—The pupa is an inactive irregularly shaped body of a pale greenish color, marked with small black spots. (See figure 20, b.)

The Adult.—The butterfly is creamy white in color, with a wing expanse of about two inches. The fore-wings are tipped with black, and marked also in the male with two, and in the female with one black dot. Figure 20, male and female.

LIFE HISTORY.

The insects, which winter in the chrysalides, come forth in the spring, and soon begin to deposit their eggs on the cabbage plant. These soon hatch and the worms begin to eat of the foliage. They are voracious eaters, and in the course of two or three weeks have attained their growth, and leaving the plant in most cases, shelter under some near protection, and transform into the pupa. In this State, they remain in this condition eight or ten days, when the chrysalis splits open along the back and the butterfly escapes. In a few days the newly hatched females deposit eggs for a second brood.

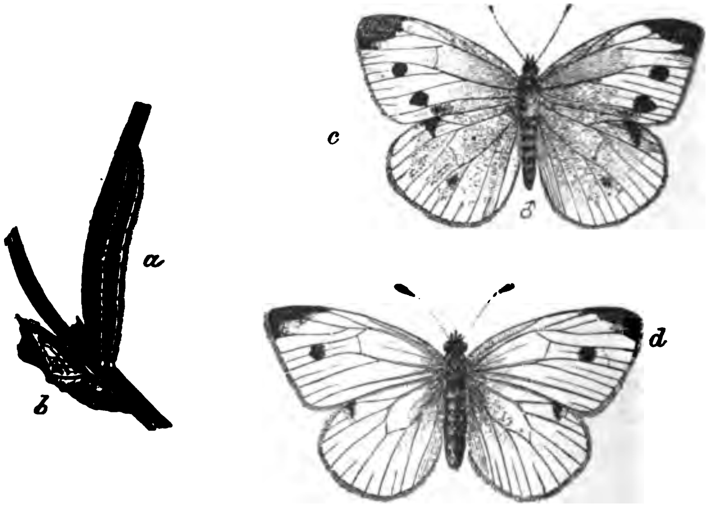

Fig. 20.—*Pieris rapæ*: a, larva; b, pupa; c, adult male; d, female.

TREATMENT.

Fortunately the larvae, when young and most susceptible to insecticides, are found mostly on the outer leaves of the cabbage. It is at this time that the best results from treatment are obtained. A very cheap and efficacious remedy is to be found in the use of Paris green. It should be used preferably in the liquid form in the proportion of one-fourth pound of Paris green to one barrel of water, or a teaspoonful to a pail of water. It should be applied with a spray nozzle that will insure a uniform and even distribution of the poison. It may also be used with good results by first mixing with flour in the proportion of one to twenty, and dusted on with a Powder Gun, or through a cloth bag. While it is hardly probable that poisoning would result from eating matured heads thus treated, it is advisable not to use the arsenites, after the heads have begun to form. Pyrethrum or "Buhach" may be substituted for the arsenites, as it is quite harmless to man. It may be dusted over the plants, or applied as a spray, one ounce of pyrethrum to three gallons of water. Diluted kerosene emulsion is to be recommended for use, until the plants begin to head; it should then be discontinued as it may taint the leaves. Lime and ashes when dusted over the leaves are also of great value. Much good can be done by hand-picking, and catching the butterflies with a net.

THE SOUTHERN CABBAGE BUTTERFLY.

(*Pieris protodice*, Bd.)

The larvae of this butterfly are also quite destructive to cabbage, being among our most common "cabbage worms." Their manner of feeding is essentially the same as that of the preceding species. This insect is a native of the United States, being much more common in the South than elsewhere.

DESCRIPTION.

The Eggs.—The eggs are elongated, pointed, of a greenish color, about three-hundredths of an inch in length. They are deposited singly, on the under sides of the leaves.

The Larva.—The worm is soft-bodied, greenish-blue, with four yellow, longitudinal bars extending down it, and sprinkled with minute black dots. See fig. 21, a.

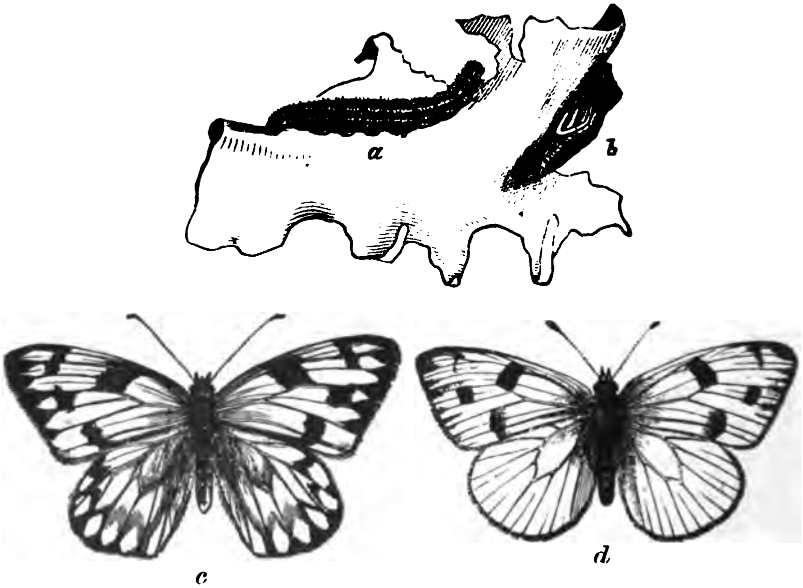

Fig. 21.—*Pieris protodice:* a, larva; b, pupa; c, adult female; d, male.

The Pupa.—The chrysalis (see fig. 21, b) is somewhat more than one-half inch in length, usually of a bluish-gray color, thickly peppered with black dots.

The Adult.—This butterfly much resembles *Pieris rapae*, being of about the same size, and of the same general color. The markings of the wings differ, however, in that they are much larger, and have a more angular outline. Figure 21, male and female.

LIFE HISTORY AND TREATMENT.

The life history of this insect is practically the same as that of the preceding species. This species is said to feed entirely on the cabbage plant.

The treatment is the same as for *Pieris rapæ*.

(*Pieris monuste*, L.)

This is another insect of the genus *Pieris*, the larvae of which are quite destructive to cabbage in the South.

DESCRIPTION.

The Eggs.—The eggs are of a light yellow color, rather oval, about four-hundredths of an inch in length. They are usually attached to the leaf by their bases.

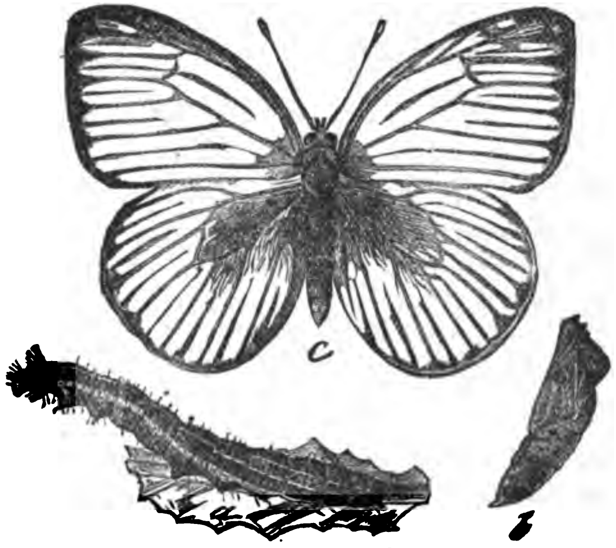

Fig. 22.—*Pieris monuste:* a, larva; b, pupa; c, adult.

The Larva.—The worm (fig. 22, a), when full grown, is about one and one-half inches in length; the body is of a yellow color, marked with four longitudinal stripes of a purplish tint. On each segment are black spots, and thinly distributed delicate bristles.

The Adult.—The butterfly (see fig. 22, c) is our largest species of the genus, with a wing expanse of from two to three inches. In the male, the front wings are white on their upper surface, and bordered with black. On the under surface of the fore-wings the color is white, with the border a pale brown or ochre color. The hind-wings on their under surface are of a yellow ochre color, the border pale brown, with a safron spot on the base. The body is white, with the thorax of a dusky tinge. The antennæ are black, ringed with white, ending in a green-colored, club-like knob.

LIFE HISTORY AND TREATMENT.

The life history of this species is quite similar to the other species of the genus *Pieris*, previously discussed.

The treatment is the same.

THE CABBAGE PLUSIA.

(*Plusia brassicae*, Riley:)

This is a night-flying moth, the larva of which is perhaps the greatest enemy to cabbage and other cruciferous plants with which the Southern truck grower has to deal. The larvae devour the foliage, and when quite numerous, strip the head of its outer leaves, even penetrating within.

DESCRIPTION.

The Eggs.—The eggs are quite small, being about two-hundredths of an inch in diameter, pale greenish-yellow in color, and somewhat convex in shape.

The Larva.—The worm, when full grown, is about two inches in lengh, soft-bodied, greenish in color, usually marked with lighter longitudinal stripes. It may be recognized from its "looping up" when crawling, after the manner of the "measuring worms." See fig. 23, a.

The Pupa.—The pupa, shown in the figure (b), is a brownish, capsule-like body, about one-half inch in length, enclosed in a web of silken threads.

The Adult.—The perfect insect is a Noctuid moth, with a wing expanse of about one and one-half inches, somewhat resembling the adult of the cut-worm. The front-wings are of dark brown color, marked with a white silvery spot, and a v-shaped mark. The hind-wings and body are of a lighter shade of brown, the abdomen ending in a brush-like tuft of hair. See fig. 23, c.

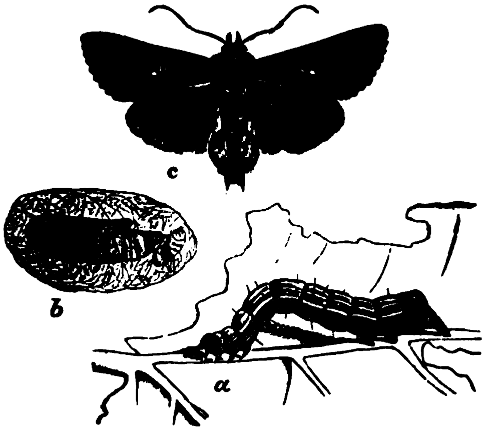

Fig. 23.—*Plusia brassicæ:* a, larva; b, pupa; c, adult.

LIFE HISTORY,

The female lays her eggs on the leaves of the cabbage plant, either singly or in groups. These soon hatch, and the small larvae begin feeding, eating small holes through the leaves; as they become older they eat out large, irregular patches. They may penetrate the head, completely riddling it, or even eating into the stalk. In about three weeks the worms have obtained their full growth, when they spin a loose, silken cocoon, and pass into the pupa state, in which condition they remain about two weeks. Upon coming from the cocoon the adult female deposits her eggs for the next brood. According to Mr. Ashmead, six broods are probably raised each season in this State.

TREATMENT.

See remedies for *Pieris rapae*.

THE CABBAGE PLUTELLA.

(*Plutella cruciferarum*, Zeller.)

Larvæ of the Cabbage Plutella are destructive to the cabbage plant, eating only the outer leaves, which they seriously damage.

DESCRIPTION.

The Larva.—The larva (fig. 24, a), is a small, green worm, a little more than one-fourth of an inch in length, very active, dropping from the plant when disturbed, and suspending itself by a silken thread.

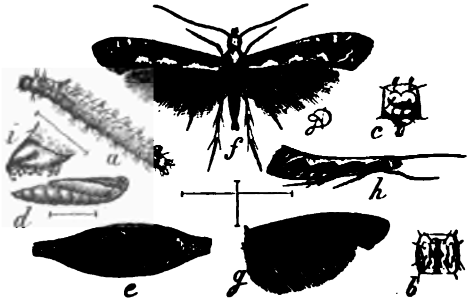

Fig. 24.—*Plutella cruciferarum:* a, larva; d, pupa; f, moth ; h, moth at rest; all enlarged.

The Adult.—The moth (fig. 24, f and h), is quite small, with a wing expanse of five-eighths of an inch, of an ash-gray color, usually with the inner margin of the forewings bordered with an undulating streak of lighter color, which, when the wings are folded together, gives a row of diamond-shaped marks down the central line.

TREATMENT.

Apply the remedies previously suggested for cabbage worms to this insect.

CUT-WORMS.

Belonging principally to the genera, *Agrotis*, *Hadena*, and *Mamestra*. There are a number of species of cut-worms responsible for much injury done to cabbage plants while they are yet young. Under the consideration of insects injurious to beans, reference was made to these worms, and remedies suggested. No further mention need be made of them here.

OTHER INSECTS AFFECTING THE CABBAGE.

Besides the species of insects previously mentioned as injurious to the cabbage, the following may be mentioned as being more or less destructive:

The Cabbage-root Maggot (*Phorbia brassicae*), which will be discussed as affecting cauliflowers; crickets (mostly *Tridactylus minutus*, Scudder); the Cauliflower Botis (*Botis repetitalis*, Grote); Locusts (*Caloptenus femur-rubrum*, and *bivittatus*) and the large locust (*Schistocerca americana*). A species of Nematode worm (*Heterodera radicicola*) sometimes seriously affects the roots of the cabbage and other garden plants, giving them a deformed and knotty appearance. This disease is usually known as "Root Knot."

INSECTS AFFECTING CAULIFLOWER.

The Cauliflower, being a variety of the cabbage, is attacked by many of the insect enemies of that plant. Owing to the peculiar requirements for the successful raising of the cauliflower, it has not been extensively grown. Its insect enemies are hence fewer, though not necessarily less severe.

THE CAULIFLOWER BOTIS.

(*Botis repetitalis*, Grote.)

Dr. A. Oemler has reported this insect to Prof. Riley as destructive to cauliflowers in Georgia, the larva eating the leaves and head and doing serious damage. The insect occurs in our own State, ravaging the cauliflower, cabbage and like plants.

DESCRIPTION.

The Larva.—The worm when full grown measures about three-fourths of an inch in length; is of a pale yellowish color, with a darker shade along the back; the head is of a deeper brown than the rest of the body.

The Pupa.—The pupa is about two-fifths of an inch long, slender, of a light brown color, the posterior end terminating in a prolonged curved spine.

The Adult.—The adult moth is rather small and delicate, with a wing expanse somewhat less than one inch; it is brownish yellow in color, the wings marked across with two irregular brownish lines, and on each fore-wing two brownish dots.

TREATMENT.

The use of an arsenite will be effective, and can be used safely before the plants begin to head. Pyrethrum should be used after this, either in powdered or liquid form.

THE CABBAGE-ROOT FLY.

(*Phorbia brassicae*, Bouche.)

This insect, affecting Cauliflower and cabbage plants, as well as other garden crops, does great damage in its larval state by eating the tender rootlets, and cutting and boring into the main root. This of itself is a great drain upon the vitality of the plant, but a not unusual result is that this eating of the roots, aided by the slimy secretion of the maggots, opens the way for rot and decay, which soon terminates the life of the plant. Usually within two or three weeks after the plants have been set out the attack of the maggots is indicated by a checking of the growth, wilting during the hottest part of the day, and by the plant showing a sickly bluish cast. These symptoms should call for a careful examination of the roots, and treatment should at once be applied. As the maggots grow and increase their ravages, the plant becomes yellowish and wilts, and will fail to form the proper head. Treatment at this stage may not always recover the plant, but will destroy the maggots, which should be an important point. A not unusual result of the attack of these maggots is a swelling of the roots, producing what is sometimes known as "club root", much resembling a similar disease caused by a fungus.

The Cabbage-root Maggot has been known in this country since 1856. It is probably another one of our imported European pests.

DESCRIPTION.

The Larva.—The maggot is a small, white, footless insect, about three-fourths of an inch in length. The body is pointed towards the head, gradually becoming larger towards the posterior end, where it abruptly ends. Figure 25, a, enlarged.

The Pupa.—The pupa is an oval brown capsule about two-tenths of an inch in length. Figure 25, b.

The Adult.—The adult is a two-winged fly, much resembling the common house-fly, but somewhat smaller; it is of on ash-gray color, with three black stripes on the thorax, and a black stripe along the back of the abdomen. See figure 25, c, enlarged.

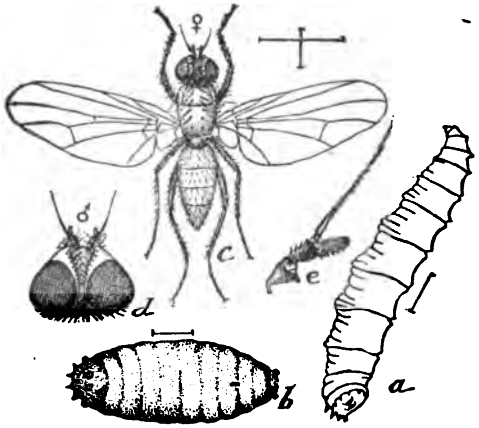

Fig. 25.—*Phorbia brassicæ:* a, larva; b, pupa; c, female fly—all much enlarged.

LIFE HISTORY.

The insects pass the winter in the larval state in the roots of the infested plant, or as a puparium in the ground, or even in the adult condition. Early in the season the female deposits her eggs around the stem, at or near the surface of the soil. These soon hatch, the maggots at once working their way into the ground, feeding upon the outer surface of the roots and rootlets. The maggots grow rapidly and soon pupate. In the course of a fortnight the perfect insects appear. Several broods are raised in a season, infesting the plants from early in the spring to late in the fall.

TREATMENT.

The use of carbon bi-sulphide applied with the McGowen Injector as illustrated and described under the head of "Spraying Apparatus", is no doubt the best and most practicable way of combating this and other insects of similar habits. Usually one treatment is sufficient, using about one teaspoonful to each plant. This will make the cost of the liquid about one cent for ten plants where carbon bi-sulphide is purchased in ten pound cans or more. In using the injector the insertion of the tube should be atleast three or four inches from the plant, and pushed obliquely downwards until the point of the injector is just below the roots, when the load of carbon bi-sulphide should be discharged. These fumes will thoroughly penetrate the surrounding soil, effectually destroying the insects. Where it is impossible to use the injector the liquid may be applied in a different way, as suggested by Prof. Cook. With an ordinary walking stick make a hole in the ground three or four inches from the main root of the plant, and pour in about one teaspoonful of the carbon bi-sulphide, quickly closing the hole by pressing down the earth with the foot. Kerosene emulsion will also prove of much value. It should be applied as soon as the attack is noticed. The earth should be scraped away from the stalk and surface roots, and the emulsion applied to the stalk and surrounding soil with thoroughness. The use of the Knapsack Pump will prove most satisfactory. Immediately after spraying, the earth should be drawn up around the roots again. Watering the plants with lime-water has been recommended. Tobacco, applied either as a decoction or in the form of dust, will be of service.

Plants that cannot recover from the attack should at once be dug up and burned. The holes left should be treated with a teaspoonful of carbon bi-sulphide, and earth raked over to hold in the fumes. Where a field has become badly infested with these insects it should not be planted to cauliflowers or cabbages for two years. This will deprive the insects of their food plants, and they will be starved out.

OTHER INSECTS AFFECTING CAULIFLOWERS.

Flea-Beetles are at times a serious pest to cauliflowers. These are small, black, jumping insects, eating pits and holes in the leaves. For treatment see discussion under cabbage.

Cabbage Worms, larvae of *Pieris rapae* and *P protodice*, eat the cauliflower in much the same way as they do the cabbage. They may be recognized and treated as recommended in the discussion given in connection with insects affecting that plant.

INSECTS AFFECTING CELERY.

THE TARNISHED PLANT BUG.

(*Lygus lineolaris*, Beauv.)

The Tarnished Plant Bug is at times quite destructive to celery, feeding directly upon the tender white stalks of the plant. Piercing these with its beak, it sucks up the sap, leaving a large, brown wilted spot, which, while stunting the growth of the plant, also greatly mars its appearance, and hence affects its market value. This pest is to be found in nearly every State in the Union, extending even down to Mexico. It is quite an omnivorous feeder, attacking nearly all kinds of garden vegetables.

DESCRIPTION.

The Nymph.—The young passes through three or four stages in reaching maturity. In the first two stages it is of a greenish color, with no trace of wings. In the later stages the wings begin to grow out, and a few dark markings appear. The shape and structure of the body are similar to that of the adult, the description of which should here be referred to.

The Adult.—The adult bug is a rather small insect, measuring about two-fifths of an inch in length; body elliptical in shape, and somewhat flattened. The sexes differ in color, the female being light brownish in color, with light yellow markings. In the male the general color is dark reddish brown, and the markings are usually absent. Figure 26, enlarged.

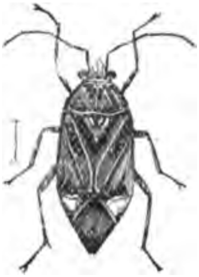

Fig. 26.—*Lygus lineolaris:* Adult; enlarged.

LIFE HISTORY.

These insects hibernate during the winter under old rubbish, boards, and other protected places, and early in the spring come out and attack the early vegetables. The eggs are soon deposited and hatched, and the young, sucking the juices of their food plant, rapidly grow into adult insects. During the day they are usually shy, hiding in the heavy foliage, darting from side to side of the stem, or perhaps taking flight. Early in the morning they seem rather adverse to flight, and may be more easily captured and destroyed at this time.

TREATMENT.

Many kinds of remidies have been tried against this bug, and not with a great deal of success. None of the arsenites can of course be used on the sucking insects. Kerosene emulsion and pyrethrum may be used with killing effect on the insects, but owing to their great activity many escape its application, and live to continue their work of destruction. Preventive measures will keep them greatly reduced. The fields should be cleaned of dead grass, rubbish, and other debris, serving as a winter retreat. Hand-picking should be resorted to at their first appearance in the spring. This will prove to be the most satisfactory way of destroying them.

THE CELERY CATERPILLAR.

(*Papilio asterias*, Fabr.)

The adult of this caterpillar is doubtless quite familiar to all, being one of the most common of butterflies frequenting the garden flowers throughout the summer. The caterpillar is destructive to celery, feeding upon its leaves, thus interfering with the assimilative powers of the plant. *Papilio asterias* is quite a common and abundant insect throughout this country, feeding also upon parsnips, carrots, parsley, and other Umbelliferous plants.

DESCRIPTION.

The Larva.—The larva is quite large when full grown, and is readily recognized from its striking color of green, with yellow and black in transverse bands. When disturbed it throws out a pair of yellow, horn-like processes from the head. These are the scent organs, and emit a very disagreeable ordor, serving to protect it against its enemies.

The Pupa.—The pupa is an irregularly-shaped body of a yellowish or ash-gray color. Projecting from the head region are two short horn-like protuberances.

The Adult.—The butterfly is quite conspicuous, having a wing expanse of over three inches. The wings are deep blackish-brown, ornamented near their outer edges with two rows of pale yellow spots. The second pair of wings differ from the first pair in having a blue-black lustre, the under surface of each being marked with seven circular spots of an orange color. The antennae are long, with a club-shaped knob on the end.

LIFE HISTORY.

It is probable that this insect passes the winter in the pupa state, coming out early in the spring. The eggs are deposited on the celery or other plants of the same family, and the larvae soon are hatched and at once attack the foliage. They are greedy worms, and before long have completed their larval growth, and pass into the chrysalis. In preparing for this state the worm attaches itself securely to some support by the tip of its abdomen and passes a silken thread around its back, fastening it on each side, leaving it in the form of a loop, which will serve to support the body. In a few hours it has become an almost quiescent chrysalis. It remains in this condition from twelve to fifteen days, and then appears as the perfect insect. Several broods are raised each season.

TREATMENT.

Ordinarily the caterpillars will not be sufficiently abundant to demand much attention. Owing to their large size and conspicuous appearance, hand-picking would be a very expedient and satisfactory way of destroying them. Pyrethrum powder may be used as previously recommended. Paris green or other arsenites should not be used on celery, as the settling of the poison in and around the edible portion might become sufficient to produce harmful results when eaten.

OTHER INSECTS ATTACKING CELERY.

Besides the insects above discussed as injurious to celery the following may be mentioned: Flea-Beetles, the small, jumping beetles which were mentioned as injurious to beans, beets, and cabbage, are also destructive to celery in the plant bed. They gnaw off the epidermis of the young plant, giving it a rough and chafed appearance. They should be kept in check by the use of pyrethrum powder. The Zebra Caterpillar (*Mamestra picta*), and other species of cut-worms also attack celery. Refer to the discussion of these insects under the head of beans for information concerning them.

INSECTS AFFECTING THE SQUASH

The squash has several insect enemies; the more important are here considered.

THE SQUASH BUG.

(*Anasa tristis*, DeGeer.)

The Squash Bugs when in considerable number do much injury to the squash vines by sucking the sap with their stout beaks, causing a wilting and stunting of the plant. This insect is a much too common pest throughout the United States.

DESCRIPTION.

The Eggs.—The eggs are oval in shape, with three sides flattened, giving them a triangular appearance. They are laid on the under or upper sides of the leaves, in large brownish patches which are quite conspicuous.

The Nymph.—Soon after hatching the young is broadly oval in shape, the head and middle body black, the abdomen an ochre yellow, with the antennae pink. In the course of two or three days the body color is changed to ash-gray. The rest of the body is black. See figure 27, showing the nymph very young, and older.

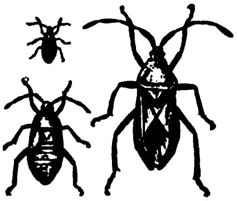

Fig. 27.—*Anasa tristis:* Young nymphs and adult.

The Adult.—The matured insect is a little more than one-half an inch in length; of a blackish brown color above, and a dirty yellow beneath. It may be easily recognized from the figure.

LIFE HISTORY.

The eggs which are deposited in the early spring soon develop into the young nymphs. These at once begin feeding, sucking up the sap of the plant. They have the habit of remaining grouped together until they have nearly attained their growth, when they become more scattered. Several successive broods are raised during the season, the mature bug passing the winter in hibernation. They spend most of the day in concealment, and at the approach of night come out from their various places of retirement and begin to feed.

TREATMENT.

With this insect, preventive measures are of more value than direct treatment. On their first appearance in the spring they should be destroyed by hand-picking, before they have had time to deposit their first laying of eggs. Much can be done to keep them reduced by keeping the field well cleaned of rubbish and all that would furnish them winter protection. Kerosene emulsion and pyrethrum have not been of much value. Burning up the vines as soon as the crop has been gathered, or plowing them under early in the fall will be of much value in keeping this insect in check.

THE SQUASH BORER.

(*Margaronia nitidalis.*)

The Squash Borer, or "Pickle Worm" as it is called in the North, does considerable damage in this State by boring into the fleshy portions of the squash and cucumber, and also in eating the leaves of these plants. It also attacks watermelons and muskmelons. This insect is an indigenous species of wide distribution, occuring in the West Indies, United States and Canada.

DESCRIPTION.

The Larva.—Body when full grown about one inch in length, and of a yellowish or greenish white color. Each segment is marked with a few elevated shiny spots with a hair-like bristle projecting from the center.

The Adult.—The adult moth is quite a beautiful insect, the general color being yellowish brown. The front-wings are each marked with irregular yellow spots not reaching the front margin, and constricted behind. The inner two-thirds of the hind-wings are marked with this same color. Their under surfaces are pearly white. The abdomen extends beyond the wings, ending in a brush-like tuft.

LIFE HISTORY.

The young larvæ, hatching from the eggs, bore into the fruit and feed greedily upon the soft, fleshy parts. In the course of three or four weeks they have grown to full size, and when ready to transform, leave the fruit, and find some leaf near the ground, which they fold and fasten with silky threads; here they spin their loose cocoons, and finally change to slender brown pupæ. If early in the summer, the moth issues from the pupa state in the course of eight or ten days, and is soon ready to deposit eggs. Later in the season the insects probably remain in the pupa for some months, passing the winter in that condition. In this State it is probable that some of them pass the winter in the adult condition.

REMEDIES.

The worms should be picked off by hand before they have had time to penetrate the squash. Fruit known to be affected should at once be gathered and fed to hogs or cows, or disposed of in such a way that the worms will be killed.

Spraying the vines with Paris green when attacked by the worms will be of much value.

Land infested with this insect should not be planted to cucurbitous crops.

THE SQUASH VINE BORER.

(*Melittia ceto*, West.)

The caterpillar of this moth does much injury to squash vines by boring into, and feeding upon the soft interior tissues of the plant, often causing its death.

This insect is widely distributed throughout the United States.

DESCRIPTION.

The Larva.—A full grown borer measures from one to one and one-fourth inches in length. The body is somewhat flattened, soft, and tapering to each end. There are ten well marked segments. Skin is rather transparent, showing the interior dorsal tube from the fourth to the tenth segments.

The Adult.—The moth is quite a showy insect with a wing expanse of one and one-fourth inches. The hind-wings are transparent, fringed and margined with brown. The thorax is of an olive color, while the abdomen is of a deep orange. The fore-wings are lustrous olive brown.

LIFE HISTORY.

The eggs are deposited on the vines, near the roots, by the moth. In about seven days the eggs have hatched into larvæ, which bore into the vine, and eat the succulent tissues within. They grow rapidly, and their presence soon becomes evident by a wilting of the vine. When the attack is very severe it may result in the death of the plant. Attaining their full growth the larvæ usually leave the vine, and burrow into the soil a little below the surface, and transform into the pupa state, and later emerge as the adult insects.

TREATMENT.

An efficient method is to cut out the larvæ from the vines. A little experience will make their detection and removal quite easy and rapid.

Fields badly infested with this insect should not be planted to cucurbitous plants. A systematic rotation of crops will prove of great value.

Much can be done by fall plowing, thus destroying the larvae and pupae.

THE STRIPED SQUASH BEETLE.

(*Diabrotica vittata,* Fabr.)

Eating the foliage of the squash, cucumber, and melon vines this insect does considerable damage, injuring these crops to the extent of many thousands of dollars annually.

This ubiquitous pest enjoys a general distribution throughout the United States.

DESCRIPTION.

The Larva.—This is a small, slender, whitish worm, with the head brownish, about one-third of an inch in length, living among the roots of the plants infested by the adults. See figure 28, No. 1, dorsal view; No. 2, side view. The lines to the left represent the natural length.

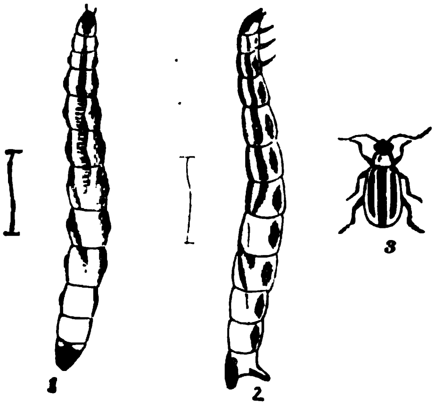

Fig. 28.—*Diabrotica vittata:* **1, 2, larva, back and side views, line to the left shows natural length; 3, adult.**

The Adult.—A small yellowish beetle, about one-fifth of an inch in length, with two black stripes on each wing cover. See figure 28.

LIFE HISTORY.

The eggs are laid by the female near the roots of the vines infested. These soon hatch, the larvae feeding on the tender rootlets causing the plant to wilt and perhaps finally die outright. When the larvae have become fully grown, which usually requires about one month, they leave the immediate vicinity of the roots, and each making for itself a little cavity, throws off the larval skin and passes into the pupa. From this state the matured insect emerges in about twelve days. Several broods are raised each season.

TREATMENT.

Where only a few hills or a small patch is to be protected, a sure protection is to be found in covering the young plants with cotton cloth, or board covers, thus keeping the larvæ from getting started among the roots, and subsequently multiplying. On a large scale, the use of Paris green, or London purple mixed with five times its bulk of flour, and sprinkled on the plants while they are wet with the early morning dew will prove of value. Instead of mixing the arsenites with flour they may be mixed with plaster, or dry slaked lime, if desirable. The arsenites may also be used in the form of a spray.

INSECTS AFFECTING THE MELON.

The insect enemies of the melon crop in Florida are at times quite numerous and severe, occasioning considerable loss by their ravages. Some of the more serious pests are here considered with suggestions for treatment.

THE COTTON, OR MELON PLANT-LOUSE.

(*Aphis gossypii*, Glover.)

These small insects are at times a serious interference to the raising of water-melons, and other plants of the gourd family. They attack the leaves and tender growing stems, sucking the sap and causing the leaves to curl and wither, and arresting the growth of young vines.

According to Mr. Pergande, assistant in the Division of Entomology, United States Department of Agriculture, this insect embraces species that have usually been considered as distinct. He has examined thousands of specimens of these supposed different species and has come to the conclusion that the Cotton Aphis, Melon Aphis, and Orange Aphis are one and the same species, and should be known as *Aphis gossypii.* Associated with this interesting discovery has been the determination of the food-plants of this insect, which are remarkably varied. Appended is a list of the more common plants upon which this aphis feeds:

Purslane, (*Portulacca oleracea*); Pepper-grass, (*Lepidium Virginicum*); Dock, (*Rumex crispus*); Dandelion, (*Taraxacum dens-leonis*); Morning-glory, (*Convolvulus, sp.*); Button-weed, (*Diodea teres*); Red Clover, (*Trifolium pratense*); Dwarf Bean, (*Phaseolus nanus*); Cotton, (*Gossypium herbaceum*); Pear, (*Pyrus communis*); Orange, (*Citrus aurantium* and varieties).

Such a large number of food-plants for insects of this class is quite unusual. Its explanation is to be found in the fact that the winged viviparous females will migrate from plant to plant, thus starting colonies here and there on their various food-plants. At the approach of fall, and when many of their food-plants become scarce, the winged viviparous females probably migrate to the orange tree, passing the winter upon its green foliage. From here, they migrate again in the spring, and become distributed upon the different plants which they attack.

DESCRIPTION.

This insect may be recognized by its general resemblance to the cabbage plant-louse, described on a previous page.

The Nymph.—The newly born lice are very small, about two-hundredths of an inch in length; the color is greenish yellow. The eyes and tips of the honey-tubes are brown.

The Wingless Viviparous Female.—Body of a yellowish color, about four-hundredths of an inch in lenth; the eyes deep brown, honey-tubes black.

The Winged Viviparous Female.—The body is ovate, and about five-hundredths of an inch in length; head and thorax black. Wings are held, roof-like, over the body; are transparent, with yellowish veins.

LIFE HISTORY.

The biology of this plant-louse is much like that of the cabbage-louse. Besides the manner just mentioned, which is employed by these insects in the continuation of their species during the winter, and a scarcity of certain food-plants, winter eggs are laid by the oviparous females in the fall, which, upon the approach of spring, hatch into the winged and wingless viviparous forms which devastate our vines and other plants.

TREATMENT.

Spraying thoroughly with kerosene emulsion will rove to be an efficient remedy. Pyrethrum powder, applied as a spray, will also be quite satisfactory.

THE MELON BORER.

(*Margaronia hyalinata.*)

In early summer this borer does much damage to the melon crop in Florida by boring into the melons and causing them to rot. The leaves and tender vines are also at times attacked by these caterpillars. This is a common and widely distributed insect, occurring in North and South America and the West Indies.

DESCRIPTION.

The Larva.—The worm is about eight-tenths of an inch in length, of a pale yellowish-green color, translucent, and sparsely haired. See figure.

The Pupa.—Body slender, yellowish-brown, about two-thirds of an inch in length, tapering towards the posterior end.

The Adult.—This moth is quite a pretty insect. The wings are white, translucent, bordered with a band of glossy brownish-black; expanse about one and one-fourth inches. The abdomen is pearly white, ending in a tuft of buff-colored hair-like scales. Legs white, excepting the fore-thighs and tibiæ.

LIFE HISTORY.

The eggs are probably deposited on the vines or leaves early in the season. The worms, hatched from this first brood, necessarily feed upon the leaves and vines. The second and succeeding broods are most destructive, eating irregular furrows in the outer rind of the melon, or just beneath it. They also attack the soft, fleshy portions, eating long galleries, partly filling them with their excrement. It is in this way that they do most damage, bringing about the souring and decay of the melon. By early summer the melon crop is frequently almost destroyed by the ravages of these worms, four to six being frequently found in the same melon.

TREATMENT.

The first brood of the worms that appears in the spring, eating the leaves and tender vines, should be destroyed by spraying with Paris green or London purple. All melons that have been infested should be gathered and fed to the hogs, or otherwise treated in such a manner that the larvæ will be destroyed. Badly infested fields should not be planted to melons the succeeding year.

THE LEAF-FOOTED PLANT BUG.

(*Leptoglossus phyllopus*, Linn.)

This common and well known insect frequently is the cause of serious trouble, by puncturing the stems of plants and sucking their sap, causing them to wilt, and, not unfrequently, bringing about their death. It attacks not only the cucurbitous plant, but quite a variety of others.

DESCRIPTION.

The Eggs.—The eggs are of a golden-brown color, cylindrical, flattened below and at the ends. They are deposited in a stiff, cylindrical, rod-like row along the stems, or the midribs of the leaves.

The Nymph.—The young have much the same form as the adult, but are of a brighter red color, and do not acquire the leaf-like expansions of the tibiæ until nearly matured. See figure 29, nymph in two stages of growth.

The Adult.—The adult insect is about three-fourths of an inch in length, of a chocolate-brown color, marked with a whitish band across the folded wings, and a spot of the same color on each of the flattened, leaf-like shanks. Figure 29.

LIFE HISTORY.

Hibernating as a perfect insect, it comes forth in the early spring, and may be found on the blooms of the strawberry, peach, and other plants, usually paired. Later, eggs are laid, the young appear, and attack the tender shoots of various plants. The adults are quite active, readily passing from plant to plant. This bug seems to have a preference for the thistle (*Cirsum*), and may usually be found, both old and young, clustered in the heads, and sucking its juices. Several broods are probably raised each year.

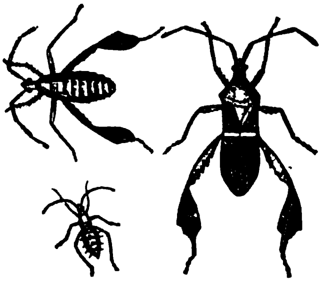

Fig. 29.—*Leptoglossus phyllopus:* two nymphs on the left; adult on the right.

TREATMENT.

The destruction of this insect may be most easily done by hand-picking. On cool, cloudy days these insects are sluggish, and advantages may be taken of a knowledge of this fact, and their destruction thus more easily accomplished.

Thistles, sun-flowers, and like plants should not be allowed to grow near fields of truck or garden crops, as in these the insects find their favorite breeding ground.

INSECTS AFFECTING THE EGG-PLANT.

The egg-plant is comparatively free from insect enemies; it is, however, attacked at times by different species of insects, of rather omnivorous habits. Following are given the more important species, with brief notes concerning them:

THE COTTON STAINER.

(*Dysdercus suturellus*, H. Schf.)

The Cotton Stainer is another Hemipterous insect that attacks the egg-plant. Its habits of feeding are quite like those of the Leaf-footed Plant Bug, puncturing the stems with its beak, and feeding on the nutrient sap within. A wilting and tardy growth are evidences of attack. This insect has long been known in the State and the West Indies as a serious pest to the cotton plan .

DESCRIPTION.

The Nymyh.—The young of this insect bears a general resemblance in form to the adult. It is of a bright red color, the legs and antennæ being black. See figure 30.

The Adult.—The matured bug is rather variable in size, but will average about one-half inch in length. It is of an oblong, oval shape, with a preponderating color of red. The wings are margined with a band of pale yellow on their outer margins, and also on their inner margins, in such a way that when closed an X-like cross is made. Figure 30, dorsal and ventral view.

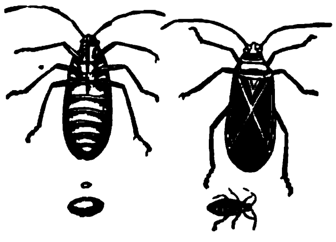

Fig. 30.—*Dysdercus suturellus:* egg, nymph, and adult; dorsal and ventral view.

LIFE HISTORY.

It is probable that the adult Cotton Stainer hibernates during the winter, and early in the spring deposits eggs for the first brood. The young grow rapidly, and soon are matured. They are very prolific, rearing several successive broods in a season.

TREATMENT.

The most satisfactory method of destroying this insect is in picking them off by hand. When they become very numerous, spraying with kerosene emulsion will keep them reduced. They may be successfully trapped with a bait of cotton seed. Small quantities of cotton seed should be placed promiscuously in the affected field. The insects which have collected in these should be destroyed by spraying thoroughly with kerosene emulsion.

THE HARLEQIN CABBAGE BUG.

(*Murgantia histrionica.*)

This bug which is so disastrous to cabbage, is also a serious enemy of the egg-plant. Its injuries are quite like those of the other Hemipterous insects which have been mentioned, sucking up the sap of the plant with its stout beak.

For description and treatment of this insect, refer to its discussion on a previous page.

PENTATOMIDS.

(Family, *Pentatomidæ.*)

Different species of this family of bugs are to be found at almost all times on the egg-plant. Two insects of this family, the Gray Pentatomid and the Green Pentatomid, are by far the more common bugs, and are probably quite well known to all as "stink bugs", for, like most of the true bugs, they emit a very disagreeable odor, which serves to protect them from their enemies.

The Green Pentatomid (see figure 31), as the name suggests, is a green, broad bodied, flattened bug, the head and the prothorax together forming a triangle. It is about one-half inch in length. The Gray Pentatomid (see figure 32, young and adult), bears a close resemblance to the preceding insect, except that it is of a gray color, and smaller.

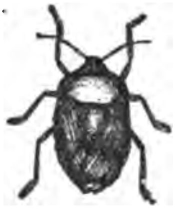

Fig. 31.—*Raphigaster hilaris:* adult.

TREATMENT.

The treatment for these insects should be the same as that recommended for the Leaf-footed Bug, and Cotton Stainer.

THE LEAF-FOOTED PLANT BUG.

(*Leptoglossus phyllopus.*)

This insect, previously described under the head of insects injuring the melon, frequently occasions serious injury to the egg-plant. The young are usually the more numerous and harmful, puncturing the tender shoots

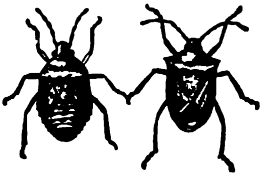

Fig. 32.—*Pentatoma punctipes:* nymph and adult.

and pumping out the sap, thus stunting the growth of the plant. Hand picking of the adults should be carefully attended to, as previously recommended in the treatment of this insect.

THE EGG-PLANT APHIS.

(*Siphonophora cucurbitæ*, Middleton.)

This small plant-louse, when abundant, does serious injury to the vines of the egg-plant. Like the other insects of the Aphis family, it sucks the juices from the leaves and tender portions of the plant, thus retarding its development and production of fruit. We may recognize this pest from the descriptions and figures given of other members of this family, as the Cabbage Plant-louse, and the Cotton Aphis. For the treatment of this insect, refer to the treatment suggested for the Cabbage Aphis.

INSECTS AFFECTING THE ONION.

The insect enemies of the onion in this State are fortunately not very numerous. The Onion Maggot, or Fly, is perhaps our most serious pest, which at times occasions severe loss to the onion grower.

THE ONION FLY.

(*Phorbia ceparum*, Meiger.)

The maggot of this fly lives in the underground portion of the onion, feeding upon its substance. The onions show signs of attack by the leaves becoming soft and weak, often becoming yellowish in color, and eventually wilting down. Such symptoms should call for careful examination, and treatment, if the pest be found. The

Onion-fly enjoys a wide distribution both in this country and Europe. It is probably indigenous to that country, and was introduced into the United States in some shipment of its food.

DESCRIPTION.

The Eggs.—The eggs are elongated, oval in shape, white and smooth. They are sufficiently large to be seen by the naked eye.

The Larva.—The larva, when it has attained full size is about one-third of an inch long, glossy, naked, and of a dull white color. The body is elongated, conical in shape, the anterior end being capable of considerable extension while feeding.

The Adult.—The adult insect, or fly, is somewhat like the ordinary house-fly, of an ash gray color, the head silvery, with a rusty black stripe between the eyes. A rather characteristic mark is to be found in a row of black dots along the middle of the hind body, sometimes so united as to form a continuous black stripe. These markings on the abdomen are much more noticeable in the male than in the female. The fly measures about one-fourth of an inch in length.

LIFE HISTORY.

These insects begin their depredations early in the season on the young and tender onion plants. The eggs are loosely deposited above the surface of the ground on the stem and basal leaves. Uusually five or six eggs are deposited on the plant. In about a week these eggs hatch and the young maggots burrow downwards within the leaf sheath, leaving discolored streaks to mark their passage; penetrating the soft cylindrical root they greedily devour the interior, leaving the outer skin; consuming one plant, it is abandoned and another is attacked. About two weeks are required for the maggot to complete its growth, when it usually leaves the onion and retiring in the neighboring soil, forms the pupa, from which it emerges as an adult fly in about a fortnight. The winter is probably passed in the pupa state in the ground.

TREATMENT.

Many different remedies have been tried in the treatment of this pest, and with varying success. This insect being of the same genus (*Phorbia*) with the Cabbage Maggot, and with practically the same life history and habits, many of the remedies that are effective against that insect will be effective also against this one.

In this case, as in the case of the Cabbage Maggot, the best remedy is probably to be found in the use of carbon bi-sulphide, but to use it would require a considerable amount, thus making it too expensive. Other less expensive remedies will therefore be needed. The use of carbolic acid emulsion against this pest has been attended with considerable success; the emulsion seems to be quite a strong killing agent, and may also serve as a repelling agent, preventing the flies from depositing their eggs, although this latter point is in question. The emulsion should be sprinkled freely around the plants as soon as they are up, and every ten days thereafter.

For the preparation of the emulsion we give the proportions as used by Prof. Slingerland, of the Cornell Station, against the Cabbage Maggot:

Dissolve one pound of soap in one-half gallon of water and thoroughly emulsify with one pint of crude carbolic acid.

For use take one part of the emulsion to fifty parts water. This makes a strong solution and may be diluted if found necessary. Raking the surface soil temporarily from the onions and thoroughly spraying the stems and bulbs with this emulsion by means of a Knapsack or other sprayer, will also be an expeditious and satisfactory way of applying the emulsion.

A mixture of lime and liquid manure, according to Mr. Dunning, has proven of much value in fighting the Cabbage Maggot. Five parts of fresh burned lime were slaked in one hundred gallons of liquid manure; this was stirred ten minutes and afterwards applied to the plants by means of a sprinkler. This same treatment for the Onion Maggot will doubtless be of much value.

Scattering dry unleached ashes over the beds as soon as the onions are up and when wet with the early morning dew prevents, to a considerable extent, the flies from laying their eggs. A field infested with this insect should not be planted to onions the next year.

WIRE-WORMS.

Wire-worms, to which reference has frequently been made, are at times serious enemies to onions, which they damage by eating the fine rootlets, and eating holes in the bulb.

Onions planted in new soil are usually much more severely attacked than those planted on older land. The precautions already alluded to in the consideration of these insects should be observed.

INSECTS AFFECTING THE TOMATO.

The growing of the tomato in this State for Northern markets has become an industry of considerable importance. The returns realized, while frequently quite satisfactory, could be greatly augmented by the recognition and proper treatment of the insects which injuriously affect them. Following are to be found the more important of these pests.

THE BOLL-WORM: CORN-WORM.

(*Heliothis armigera*, Hubn.)

This insect is by far the most serious pest with which the tomato grower has to deal. It bores into the green or ripe fruit, greedily feeding upon the interior; or in rare cases it will attack the stem, boring into and eating downwards in the central pith. This usually results in the death of the part affected, and, in case the attack was made on the main stem, in the death of the entire vine. The amount of damage done by these worms varies considerably in different localities, and also in different fields in the same locality. Tomato fields that are somewhat isolated, and planted on new soil, seem to enjoy much greater freedom from the pests than those planted in older fields, and in proximity to fields planted to corn.

The amount of damage done by a single worm throughout its life is not very definitely known. One worm will not unfrequently eat into and destroy as many as three tomatoes in a single day, while two might be considered an average number. Many tomatoes are slightly eaten into and then left, and another attacked, the worm going from one fruit to another, thus causing many to rot. It is in this way that they do much damage, not unfrequently destroying one-fourth or one-third of the crop. In extreme cases the damage may be even more than this.

This insect is quite a serious pest to other crops than the tomato. It is the insect that is so injurious to the cotton crop throughout the South, eating into and destroying the boll. It also attacks the corn, particularly garden corn, eating the leaves, and eating into the ear. Peas, beans, squashes, and potatoes are also food for this insect. Corn, however, seems to be its favorite food.

The Cotton Boll-Worm is quite widely distributed over many of the countries of the world. It is found in Mexico, the West Indies, South America, Europe, Africa, Asia, and Australia. It is quite an abundant insect in the United States, particularly in the South.

DESCRIPTION.

The Eggs.—The eggs are whitish, somewhat oval in shape, and sculptured with polar ribs, and cross furrows. It is about one-twentieth of an inch in diameter.

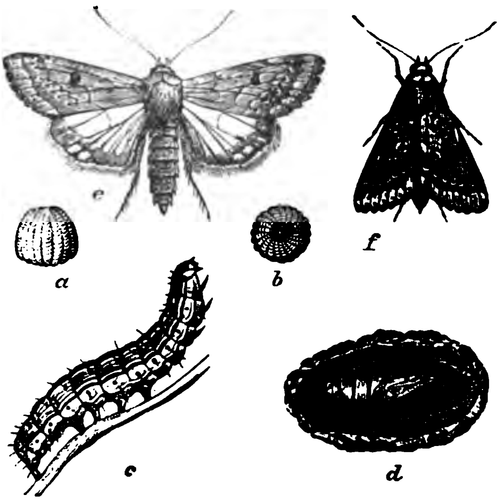

Fig. 33.—*Heliothis armigera:* a and b, egg enlarged; c, larva; d, earthen pupa case; e and f, moth; all natural size.

They are deposited here and there on the food plant, being stuck on by a white, viscid substance secreted by the moth. Figure 33, a and b, much enlarged.

The Larva.—The worm varies much in color, from pink to quite blackish, the blackish colored ones being much more abundant in the latter part of the season. The markings are also quite noticeable; rather narrow, pale, longitudinal stripes are unsually to be found on the body. When full grown, the worm measures from one and one-fourth to two inches in length. See figure 33, c.

The Pupa.—The pupa of the Boll-Worm is oval in form and about three-fourths of an inch in length. In pupating, the worm enters the earth, burrowing down three or four inches, making an oval resting case which it lines witb loose silk. Two or three days after the cell has been completed the worm has become the pupa. The pupa is at first of a beautiful green color, soon turning to a polished light brown or mahogany. See figure 33, d.

The Adult.—The moth (figure 33, e and f) is quite a variable insect, both in color and in markings. In color, it varies from a light yellowish gray to a dusky yellow. The hind-wings are bordered with a broad dark band on their outer margins; inside of this band is usually to be found a white spot varying much in size and shape, see the figure. The fore-wings are frequently bordered somewhat like the hind-wings, and marked with a spot near the centre. All of these characters however are quite variable, being almost absent in some, and quite well defined in others. When at rest, the wings are not held roof-shaped over the body, as is the case with most moths of the Noctuid family, but loosely, and slightly elevated so that the inner margin of the hind-wings, and a portion of the abdomen are visible. The wing expanse varies from one and one-half to two inches.

LIFE HISTORY.

The insects in most cases pass the winter in the pupa state; a few are said to hibernate. Early in the spring, the moths from these pupæ deposit their eggs on a variety of plants, as early beans and peas. This brood becomes at times quite destructive to these crops, the larvæ feeding on the pods. The succeeding broods soon become quite confused as to the time of appearance. Adults, eggs, pupa, and larvæ may all be found in the field at the same time. The food for these broods is quite varied.

Of all plants, the larvæ seem to prefer the corn, and if near corn-fields, the moths deposit their eggs on that plant. In the absence of this food-plant, tomatoes, squashes, tobacco, and other plants may be attacked. Feeding upon the corn the larvæ eat the leaves, quite riddling them with holes; later, as the ear begins to form, it is attacked, the worms boring into it, usually near the free end, and feeding upon the soft, milky grain within. Several worms may be found in the same ear, though usually of different sizes. Becoming tired of one ear, another is attacked, and still another, thus opening the way for the souring and decay of corn that probably was not seriously damaged by the attack of the worms. Later in the summer, when the corn has "set," or become hard, it is not so much relished by the worms. About this time the cotton is beginning to form bolls, and these, young and tender, are now attacked and eaten into, and the interior partly devoured. The worms in this way do untold injury to the cotton fields, and in certain localities almost destroy the crop. As in the case of the corn plant, the worms do not confine themselves to one boll, nor to one plant, but pass from one to another quite readily.

Perhaps next in importance, to the damage done to cotton and corn, comes that done to tomatoes. As soon as the young fruit has begun to form they are attacked by the worms. This fruit, from its being the earliest, is quite valuable, and is quite a loss to the grower.

The eggs are deposited by the moths during the evening and night on the leaves of the tomato vine. The larvæ are soon hatched and begin to feed near the place of their birth. Soon becoming restless, however, they migrate here and there over the plant until a tomato is found, which is at once attacked. The smaller worms seem to confine their attack to the smaller fruit,' the larger, to the older and more mature.

Concerning the number of broods each season, nothing can be very definitely said. Appearing early in the spring, they continue until the cold weather approaches. The number of broods is hence greatly affected by the length of the season. About thirty days are required for the insect to complete its life cycle; that is, pass through all its stages; so it is seen that in this State there may be probably six or seven broods.

The pupæ of the last brood remain in the earth until the next spring. In our State it is not improbable that many of the insects pass the milder winters in the adult condition.

TREATMENT.

Much time and money have been spent to find satisfactory remedies against this insect; but from the fact that the worm spends most of its time in the interior of the fruit, it is not easily gotten at, and treated with arsenites or emulsions, as are many of our other pests. Hence, we must resort to other means than the ones commonly in use.

Perhaps one of the best ways to combat this insect is to be found in the use of corn, as a catch plant. Hills of early corn should be planted in every fifth hill of every fifth row throughout the tomato field. The moths will deposit the greater part of their eggs on this corn, which should be used as fodder, before the larvæ have grown large enough to pupate. This will keep them greatly reduced. Something in the way of preventive measures may be done.

All wormy tomatoes which are found during the picking over of the patch should be taken to the packing-house and there sorted out and fed to hogs, or otherwise disposed of in such a way that the worms within will be destroyed. Picking the wormy tomatoes and throwing them down in the patch does not destroy the worms; they soon leave the fallen fruit, and either burrow into the ground to pupate and later emerge as a moth to deposit eggs, or else the worm will again attack the fruit and finish its growth.

Fields that have become badly infested with this insect should not be planted to tomatoes, or other plants that will furnish food for the worms. The first brood in the spring should be destroyed, as far as possible, by hand-picking. This will greatly reduce the insects which would otherwise appear later, as the descendants of the first brood.

THE TOMATO WORM.

(*Phlegethontius carolina.*)

The tomato worm, or tobacco worm, as it is quite frequently known, is often found feeding upon the foliage of the tomato, egg-plant, and tobacco, quite stripping them of leaves, and doing harm in this way. This is an insect of quite general distribution, being found in the United States and South America.

DESCRIPTION.

The Eggs.—The eggs are spherical in shape, smooth, of a yellowish-green color, and are about one-twentieth of an inch in diameter.

The Larva.—The full grown Tomato Worm measures about three or four inches in length. The head and body are dark-green, marked with lateral oblique white bands edged above with bluish. On one of the caudal segments of the back of the worm there is a slightly curved, horn-like process with which the animal is erroneously thought to produce a sting. See fig. 34.

The Pupa.—Dark reddish brown, about two and one-half inches in length, oval in form; about four times as long as thick. The tongue case projects out from the head, not quite reaching the abdomen. Fig. 35.

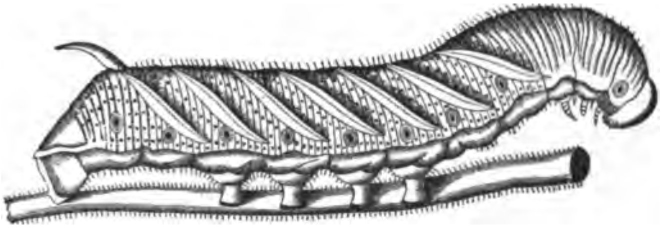

Fig. 34.—*Phlegethontius carolina:* larva.

The Adult.—The moth is a very large insect, heavy bodied, with a wing expanse of about five inches. The general color is brownish-gray. The hind-wings are marked with two rather indistinct angulated bands. Each fore-wing is usually marked at its base with a white spot. On each side of the abdomen are five orange-colored spots, bordered with black. See fig. 36.

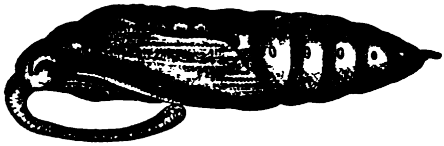

Fig. 35.—*Phlegethontius carolina:* pupa.

LIFE HISTORY.

The eggs are usually laid on the under sides of the leaves, upon which the larvæ are to feed. The worms are voracious feeders, and eat large quantites of the foliage, sometimes quite stripping the plant. They have little inclination to move during the day, and on account of their resemblance to the foliage upon which they feed, are not usually detected until the ragged leaves attract our attention. When the worm has attained its growth it leaves the plant upon which it has been feeding, and makes for itself a hole in the ground several inches deep. In this, it transforms to a quiescent chrysalis, casting off its larval skin and becoming reduced about one-third in size. It probably remains in this condition during the winter, or it may be that two or more broods are raised each season in this State.

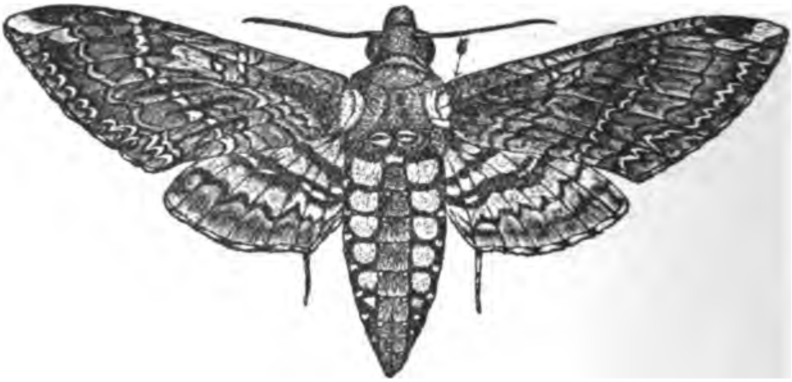

Fig. 36.—*Phlegethontius carolina:* adult.

The moth, coming from this chrysalis, is not of itself harmful, as it feeds upon the honey of flowers, sucking up the sweets with its long tongue; but as it deposits its eggs here and there on our plants, which will hatch into worms, we must still consider it our enemy. During the daytime the moths remain at rest, coming out early in the twilight to feed and lay their eggs. The moth much resembles a humming-bird in its motions as it hovers over the flower, making a humming noise with its wings. From this resemblance, it is sometimes known as the "humming-bird moth."

TREATMENT.

This worm will hardly ever be so abundant as to require other means than hand-picking for its destruction, as regards the tomato. It at times, however, becomes quite injurious to the tobacco plant. For such cases besides hand-picking, there is another quite efficient remedy which we may direct against the adult, and thereby prevent her from laying her eggs. The adults are partial to the nectar of the common Jamestown-weed (*Datura stramonium*), and we may take advantage of this habit and use it to bring about their destruction. Jamestown-weed should be planted among the tomato or tobacco plants, and into the blossoms, just before twilight, should be poured sweetened water poisoned with Paris green. The moths, sucking this in their search for nectar, will be killed, thereby removing the source of much trouble.

THE TOMATO APHIS.

(*Megoura solani*, Thomas.)

This Aphis has been reported as doing considerable damage to tomato vines in Florida, particularly in early spring, when they may exist in such numbers as seriously to interfere with the development of the plants, and in extreme cases cause their death. This plant-louse injures the vines by piercing the epidermis with its beak and pumping up the sap, after the manner of the other plant-lice and bugs considered. This insect is quite widely distributed over the United States.

DESCRIPTION.

The Nymph.—Body oblong in form, pale, with a dark green stripe along the middle of the back; head whitish, with the eyes brown. Honey-tubes long, slender, and dusky at the tips.

Winged Female.—General color of the body greenish; antennæ dusky; honey-tubes extending beyond the abdomen, greatly enlarged and expanded at the tip. The tail of moderate length, of about one-third the length of the honey-tubes. Wings with a large elongated stigma.

LIFE HISTORY.

These insects probably pass the winter in the winter eggs laid by the oviparous females in the fall. These hatch in the spring into the viviparous females, which bring forth their young alive, all through the warm season. At the approach of cold weather these viviparous forms probably give birth to true males and females, which produce the winter eggs.

TREATMENT.

The treatment recommended for the Cabbage Aphis should be applied in this case.

FLEA-BEETLES.

While the young tomato plants are yet in the seed-bed they are attacked by these small jumping Flea-Beetles. The beetles eat the tender leaves and shoots, thereby causing serious trouble.

For description and remedies see the discussion of this insect under the head of insects destructive to cabbage.

SOME ANIMALS WHICH DESTROY INSECTS.

Various species of animals prey upon insects and should be encouraged generally. The Sparrow-Hawk (*Falco sparverius*), Butcher Bird (*Lanius ludovocianus*), and King Bird (*Tyrannus carolinensis*), are among the valuable bird friends. They should be allowed to live and breed around the farm in safety.

Our Common Toad (*Bufo lentiginosus*), and Chamæleon (*Anolis principalis*), feed almost entirely upon insects, and do much to destroy our insect enemies.

ACKNOWLEDGMENTS.

In the preparation of this bulletin the various entomological writings and Experiment Station bulletins have been consulted, and drawn upon for suggestions and methods of treatment. For these, due acknowledgements have been given in the proper places.

To Prof. P. H. Rolfs, I desire to express my thanks for assistance, and many valuable suggestions given.

All of the figures of insects, except those hereafter mentioned, were obtained from the United States Department of Agriculture, Washington, D. C., through the kindness of Mr. L. O. Howard, U. S. Entomologist.

Figures 20 and 28 have been secured through the kindness of Mrs. C. V. Riley, from the drawings of the late Professor Riley.

For the use of figure 13 we are indebted to Prof. Lawrence Bruner, Lincoln, Neb.

Figure 9, illustrating the McGowen Injector, was kindly loaned us by Prof. M. V. Slingerland, of the Cornell Station.

Tabulation of the Insects
AND
THEIR TREATMENT.

TABULATION OF THE INSECTS, AND THEIR TREATMENT.

Plants Attacked.	Insect Enemy.	Treatment.	How Applied.
Bean.	Cut-Worms (Larvæ of the genera *Agrotis*, *Hadena* and *Mamestra*.)	Poisoned bait.	Poison cabbage leaves by dipping in water poisoned with Paris green.
			Poisoned bran placed promiscuously in the field.
		Board traps.	Place around in field. Examine frequently, and kill worms hiding beneath.
	Bean Weevil (*Bruchus obtectus*.)	Carbon bi-sulphide.	In tight barrel or bin.
	Red-Legged Locust (*Caloptenus femur-rubrum*.	Poisoned bran as bait.	Mix with bran enough Paris green to give it a greenish tint. Place around promiscuously in field. (Keep away from fowls or stock.)
	Flea-Beetles. (*Phyllotreta vittata*, and others.)	Paris green, Pyrethrum powder, Lime, Ashes.	As a spray, or in the form of powder. Dust on in early morning.
	Wire-worms. (*Elateridæ*.)	Preventive measures.	Keep fields cleared of logs, brush, etc.. thus lessening places for laying eggs.
	Boll-worm. (*Heliothis armigera*.)	Pick off by hand.	
Beet.	Blister-Beetle. (*Epicauta vittata*.)	Paris green or London purple. Hand picking.	In the form of spray or powder.
	Cut-Worms. (Larvæ of *Agrotis*, *Hadena* and *Mamestra*.	Same as for bean.	Same as for bean.
	Leaf-hoppers, Bugs, and Plant-lice. (*Hemiptera*.)	Kerosene emulsion.	Spray.
	Wire-Worms. (*Elateridæ*.)	Same as for bean.	Same as for bean
Cabbage.	Cabbage-Worms. (Larvæ of *Pieris rapæ* *Pieris protodice*, *Pieris monuste*, *Plusia brassicæ*, *Plutella Cruciferarum*.)	Paris green or London purple before plants begin to head. Pyrethrum after heading begins.	In the form of spray or powder.
		Dilute Kerosene emulsion before plants begin to head.	Spray.
		Lime; ashes.	Dust on in early morning.

TABULATION OF THE INSECTS, AND THEIR TREATMENT.

Plants Attacked.	Insect Enemy.	Treatment.	How Applied.
Cabbage (Con.)	Harlequin Cabbage Bug; Calico Back. (*Murgantia histrionica.*)	Preventive measures.	Cleaning fields of trash in fall.
		Hand picking first brood.	
		Planting catch plants.	Plant early radish, rutabaga, or turnip plants. Spray the insects which collect on these with kerosene emulsion.
	Cut-Worms. (*Agrotis Hadena* and *mamestra.*)	Same as for bean.	Same as for bean.
	Flea-Beetles. (*Phyllotreta vittata* and others.)	Lime; tobacco dust	Dust on in early morning.
		Dilute kerosene emulsion.	Spray.
		Tobacco decoction	Spray.
	Cabbage-root Maggot. (*Phorbia brassicæ.*)	Same as for Cauliflower.	Same as for cauliflower.
	Cabbage Plant-Louse. (*Aphis brassicæ.*)	Kerosene emulsion, diluted.	Spray.
	Cauliflower Botis. (*Botis repetitalis.*)	Same as for cauliflower.	Same as for cauliflower.
	Locusts, grass-hoppers. (*Caloptenus femur-rubrum, Caloptenus bivittatus, Schistocerca americana.*)	Same as for bean.	Same as for bean.
Cauliflower.	Cabbage-Worms. (*Pieris rapæ; Pieris protodice.*)	Same as for cabbage.	Same as for cabbage.
	Cabbage-root Maggot. (*Phorbia brassicæ.*)	Carbon bi-sulphide	Applied with the McGowen Injector as explained under description of insect.
		Kerosene emulsion. Carbolic acid emulsion.	Apply around the stem and roots.
Celery.	Tarnished Plant-bug (*Lygus lineolaris*)	Preventive measures.	Keep fields well cleared of rubbish, thus removing winter retreats.
		Hand picking at first appearance in spring.	

TABULATION OF THE INSECTS, AND THEIR TREATMENT.

Plants Attacked.	Insect Enemy.	Treatment.	How Applied.
Celery (Con.)	Flea-Beetles. (*Phyllotreta vittata* and others.)	Pyrethrum.	As a spray, or in the form of powder.
	Zebra Caterpillar. (*Mamestra picta.*)	Same as for bean.	Same as for bean.
	Celery Caterpillar. (*Papilio asterias.*)	Hand picking.	
		Pyrethrum when very abundant.	As a spray or powder.
Squash.	Squash Borer. (*Margaronia nitidalis.*)	Paris green when the worms attack the vines.	Spray.
		Hand picking before the larvæ enter the squash.	
		Rotation of crops.	Infested fields should not be planted to cucurbitous crops.
	Squash Vine Borer. (*Melittia oeto.*)	Cutting out the larvæ from vines.	
		Bi-sulphide of carbon when the roots are attacked.	Same as for Cabbage Maggot.
		Preventive measures.	Infested fields should not be planted to cucurbitous crops.
	Striped Squash Beetle. (*Diabrotica vittata.*)	Paris green or London purple.	As powder mixed with 5 parts of flour, or spray.
		Cloth or board covers where only a small area is to be protected.	
	Squash Bug. (*Anasa tristis.*)	Preventive measures.	Keep all trash cleared from field.
			Burn vines as soon as crop is gathered.
Melon.	Melon Borer. (*Margaronia hyalinata.*)	Paris green for first brood which may attack foliage.	Spray thoroughly.
		Destroy infested melons by feeding to hogs or otherwise.	
	Cotton, or Melon Aphis. (*Aphis gossypii.*)	Kerosene emulsion. Pyrethrum.	Spray.
	Leaf Footed Plant Bug. (*Leptoglossus phyllopus.*)	Destroy by hand picking.	

TABULATION OF THE INSECTS, AND THEIR TREATMENT.

Plants Attacked.	Insect Enemy.	Treatment.	How Applied.
Egg-Plant.	Harlequin Cabbage bug. (*Murgantia histrionica*,)	Same as for cabbage.	Same as for cabbage.
	Cotton Stainer. (*Dysdercus suturellus*.)	Kerosene emulsion	Spray.
		Cotton seed for bait.	Place small quantities of cotton seed around in field. Insects congregating on these baits should be killed by spraying with kerosene emulsion.
	Leaf-Footed Plant Bug. (*Leptoglossus Phyllopus*.)	Destroy by hand picking. Kerosene emulsion when very abundant.	Spray.
	Pentatomids. (*Pentatomidæ*.)	Hand picking. Kerosene emulsion when numerous.	Spray thoroughly.
	Egg-Plant Aphis. (*Siphonophora cucurbitæ*.)	Same as for cabbage louse.	Same as for cabbage louse.
Onion.	Onion-root Maggot, Onion Fly. (*phorbia ceparum*.)	Carbolic acid emulsion.	Spray thoroughly the stems and soil as soon as plants are up, and continue every ten days.
		Lime and liquid manure.	Apply with sprinkler.
		Ashes.	Dust on in early morning.
	Wire-Worms. (*Elateridæ*.)	Same as for bean.	Same as for bean.
Tomato.	Boll-Worm. (*Heliothis armigera*.)	Early corn as a catch plant.	Plant hills of corn in every fifth hill of every fifth row. Feed to stock before the worms pupate.
		Preventive measures.	Do not plant tomatoes near corn fields. Destroy all wormy tomatoes. Badly infested fields should not be planted to tomatoes.
	Flea-Beetles. (*Phyllotreta vittata* and other species.)	Same as for bean.	Same as for bean.
	Tomato Aphis. (*Megoura solani*.)	Same as for Cabbage Aphis.	Same as for cabbage aphis.
	Tomato Worm. (*Phlegethontius carolina*.)	Hand picking. Poisoned sweetened water for adults.	Poison and sweeten water. Pour into flowers of Jam'stown weed (*Datura stramonium*) just before dark.

COST OF MATERIALS FOR MAKING SPRAYING SOLUTIONS, AND WHERE THEY MAY BE OBTAINED.

Below is given a table showing the cost of chemicals recommended in this bulletin, when bought in the quantity given in this table. If a large quantity is to be used it can be had cheaper. These chemicals may be obtained from J. C. L'Engle, No. 1 East Bay street, Jacksonville, Florida:

Ammonia water (26° B), in 7-pound bottles, 12 cents per pound, and 20 cents for the bottle.

Arsenic, white, 10 cents per pound.

Carbonate of Ammonia, 15 cents per pound.

Carbonate of soda (sal soda), in 5-pound packages, 4 cents per pound.

Carbon bi-sulphide (bi-sulphide of carbon), 25 cents per pound, in 1-pound cans.

Caustic soda (70 per cent.), in 50-pound cans, 7½ cents per pound.

Copper carbonate, 46 cents per pound.

Copper sulphate (blue stone), 7 cents per pound, in 10-pound packages.

Lime, quick, 90 cents per barrel.

London purple, 27 cents per pound.

Napthaline, 8 cents per pound, in 10-pound cans.

Paris green, 35 cents per pound.

Potassium sulphide, 39 cents per pound, in 5-pound packages.

Pyrethrum, insect powder, 21 cents per pound.

Resin, Rosin, $2 per barrel of 180 pounds.

Sulphur (flowers), 3 cents per pound, in 50-pound packages.

Tobacco dust, barrels. 3 cents; smaller quantities, 4 cents.

Tobacco stems, 1½ cents per pound, in 50-pound packages.

Bulletin No. 35. April, 1896.

FLORIDA
AGRICULTURAL EXPERIMENT
STATION.

CASSAVA,

THE VELVET BEAN,	CANAIGRE,
PRICKLY COMFREY,	ALFALFA,
TARO,	FLAT PEA,
CHINESE YAM,	SACHALINE.

BY O. CLUTE.

The Bulletins of this Station will be sent free to any address in
Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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1896.

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A Growing Cassava Plant

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half good muck, four tons per acre will be valuable. On our land at Lake City I have used 300 pounds per acre of a mixture made up of 300 lbs nitrate of soda, 400 lbs cotton and meal, 800 lbs superphosphate, 500 lbs muriate of potash. applied in the drill, and well worked in. Almost any of our high pine lands will yield 6,000 to 8,000 pounds per acre of cassava, without any fertilizer at all. It will be more economical to give fertilizer and get 12,000 to 16,000 pounds per acre.

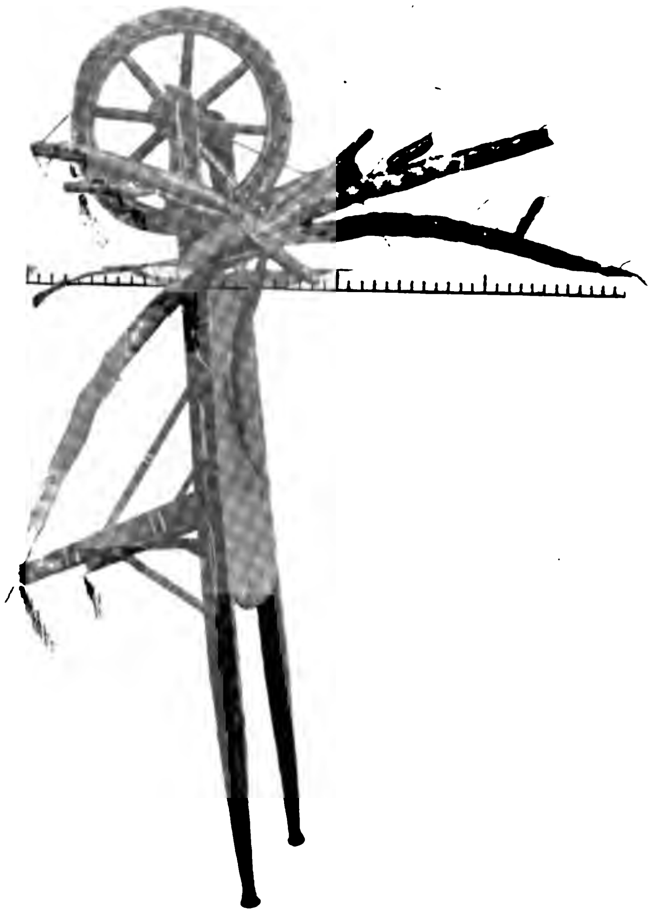
SEED.

In the latitude of Lake City, cassava has a season long enough to bloom and ripen some seed. This takes a season of about nine months without frost. In the neighborhood of Fort Myers it will doubtless ripen a large quantity of seed every year. The matter of bloom, and of ripe seed from it, is of no importance, except as it indicates a long season in which the fleshy roots may grow, for the seed produced from the bloom is not usually planted, unless, as in the case of the potato, one desires to produce new varieties. Cassava, like sugar cane, is usually grown by planting the tops or canes. These branch irregularly, and have many knots or protuberances, and also "eyes" or buds, from which new plants spring.

These canes are banked in the fall so as to be kept from frost. About the tenth of March, in North Florida, they are taken from the bank, cut into pieces six to eight inches long, with several eyes or buds to the piece, and these pieces are planted very much as we plant Irish potatoes. In cutting the seed be careful that the pieces are not split or shattered.

PREPARING THE SOIL AND PLANTING.

The soil should be well plowed, as for corn or potatoes. Lay off the rows four feet apart, and the hills four



feet apart in the row. Make the furrows, scatter the fertilizer in the furrows, and work it into the soil. Drop a piece of seed for each hill. If you have plenty of seed drop two pieces for each hill, as this will insure a better stand. Our men when planting usually have bare feet and step on each piece of seed when dropped. This presses it closely into the soil, and firms the soil around it, thus helping to prevent the soil from drying out. Cover from three to four inches deep by turning a furrow on it. Run a roller over the rows to press the earth down. If the seed is covered with a hoe the men should step on each hill as covered. A dry spell after planting is apt to dry the seed so that it does not grow, and this firming of the soil is an item of importance.

Some growers prefer to plant the seed so that the top end of each piece is just at, or slightly above, the surface of the soil. This would usually bring each piece in a slanting position in the furrow. This method does not permit the firming of the soil so easily as the one above mentioned.

SPROUTING THE SEED.

Many growers of cassava find a difficulty in getting a good stand. Some of the buds have so little vitality that they do not grow. Or a dry spell after planting dries the seed out. Or ants and wood-lice attack the seed and cut out the buds. To overcome these difficulties some successful growers adopt the "bedding system." The pieces of seed are laid near together on a properly prepared bed, covered lightly, mulched with pine straw or moss, and plentifully watered as often as necessary. Then, when the buds have swelled and just begun to sprout, plant in the field.

CULTIVATION.

Cultivate as for corn. Roots run near the surface, hence cultivating should be done with care. After the long fleshy roots begin to shoot out from the collar or just below, it is specially important to avoid disturbing or breaking them. When the plants shade the soil pretty well cultivation may stop.

DESCRIPTION OF PLANT. As may be seen from Fig. 1,the plant has a vigorous growth. On poor soil it reaches four to five feet in height, and on good soil is even more luxuriant. The roots run out from the collar horizontally in all directions. They are one and a half to three and a half feet long; sometimes five feet long; from one inch to two and a half inches in diameter; about the same size from end to end; smooth, brown in color, tapering to a blunt point, having few rootlets. Many of them run so near the surface that often the surface soil is thrust upward in narrow ridges by the growing roots. Some roots run deeper.

The yield depends on conditions. On wet soil the plant fails entirely. On well drained, sandy soil of poor quality, it yields from three tons to ten tons of roots per acre. On good soils with fair fertilization and cultivation the yield is from ten tons to twenty tons per acre Much larger yields are sometimes reported.

HARVESTING.

The horizontal growth of many of the roots near the surface is one of the valuable qualities of cassava, for it renders the harvesting comparatively easy. In harvesting, the tops may first be cut about four inches from the ground, then a man on each side of the row lifts the plant slightly by thrusting in a strong shovel, and the two men grasp the top near the ground, and with a pull

lift the whole mass, with the roots still hanging to the tops. If some roots break off in the ground, they are dug separately. The roots may at once be broken from the collar and hauled to the stables, pens or feeding lots.

After they are taken up the roots blacken and sour in a few days in warm weather, hence it is best to dig at one time only enough to last the animals for a day or two. In cool weather the roots will keep ten days or more after being dug, without injury. When left in the ground undisturbed the roots keep indefinitely, when not frozen. In Central and South Florida the plants may be left in the ground from year to year, the grower simply going along the rows and digging such roots as are sufficiently grown, and leaving the plant to form more roots. Even as far south as Fort Myers the stems lose their leaves in winter, but in Fort Myers and further south there is not usually enough frost to kill the main canes, and in February these send out a new growth. In North Florida we usually have frosts by the last of November, or in December, sufficiently severe to kill the leaves and canes. Most winters there is not enough frost in North Florida to injure the roots in the ground, hence these may be dug from day to day as needed for the stock.

SAVING SEED.

In North Florida the canes for next year's planting are stripped of leaves and smaller branches, laid in a snug pile on a dry place and covered with a layer of hay, straw or moss, and then with enough sand to keep out the frost. If the winter is unusually dry it is best to pour a few pails of water over the piles two or three times during the winter.

FEED FOR STOCK.

All domestic animals eat cassava and thrive on it. Of the recently dug roots give them what they will eat two or three times a day. Horses and mules that are worked should have two to four quarts of corn or oats per day, and also good hay, in addition to cassava. Cows increase in milk when fed cassava, and the milk is of excellent quality. Hogs grow well when fed cassava, and are healthy. They do not get very fat, but make excellent bacon and first-rate hams. Of course very fat hogs do not make pork as palatable or desirable to most people as hogs of medium fatness. If very fat hogs are desired, they can be fed corn a few weeks before killing. Fowls eat cassava eagerly.

If much sand clings to cassava when dug, the roots should be washed before feeding them to stock. Of course they can be fed whole, but it is better to slice them into pieces about one-half inch thick. This can be done with a spade or hatchet. If fed on a large scale, a machine for slicing is desirable. In feeding fowls give the whole roots. The fowls will pick them when they desire food.

FOOD FOR MEN.

A very large number of human beings get an important part of their daily food from cassava. Throughout South America, and in the Indian Archipelago, it is one of the principal sources of food, being prepared in various ways. Starch is made from it in great quantities, and from the starch the ordinary tapioca is prepared. It is not much used in Florida for human food. The roots may be boiled and served like potatoes, in which way they are quite palatable, but as most people prefer the sweet potato or the Irish potato the cassava is not popular. The fresh roots grated make nice griddle cakes and puddings.

FOR STARCH AND GLUCOSE.

It seems altogether probable that as a source of starch the growing of cassava will become an important industry. The yield per acre is so large and the amount of starch is so great that the cost of production would be small. From the starch any amount of tapioca can be made, for which a market can be found. And glucose (grape sugar), either in solid form or as a syrup, could be manufactured in any amount desired. As the canes are used for seed the planting of a large acreage, to supply starch factories, requires a somewhat large planting the previous year to provide the cane. Not much has been done, as yet, in growing plants from green cuttings, nor from the seeds produced by the blooms. I do not know that anything has been done to grow plants from the roots, as we grow sweet potato plants. Perhaps it will not grow in this way at all. These methods of propagation will be tried at the experiment station in the near future.

A SCRAP OF SCIENCE.

Cassava belongs to the same family of plants as the castor oil bean (the *Euphorbiaceæ*). There are two species which have been widely cultivated—the bitter cassava and the sweet. The bitter cassava contains hydrocyannic acid in sufficient quantity to make it poisonous, yet it is the bitter cassava that is so extensively cultivated in South America, and in some other parts of the world, for human food. The poisonous property is easily dissipated by heat, hence cooking renders the cassava palatable and harmless. The botanical name of this bitter cassava is *Manihot utilissima.* The sweet cassava contains but a very small amount of hydrocyannic acid, not enough to make it either bitter or poisonous. It may be eaten freely either raw or cooked. It is known as *Manihot Aipi.* It is this sweet cassava which is cultivated in Florida. No report has reached me that the bitter cassava is grown by anybody in this State. In books giving accounts of tropical countries cassava is often spoken of under the name of manioc, or mandioca, or mandisc. An analysis of the cassava roots grown in Florida has been made by the Department of Agriculture in Washington with the following results:

* ANALYSIS OF ROOTS OF FLORIDA CASSAVA.

Ash	per cent.,	1.94
Oil (petroleum ether extract) . . .	"	1.27
Ether extract (resins, alkaloids, organic acid, etc.) per cent.		.74
Alcohol extract (amids, sugars, glucosids, etc.), per cent.		17.43
Crude fiber	per cent.,	4.03
Starch	"	71.85
Albuminoids (calculated from nitrogen)	"	3.47
Total		100.73

The large per cent. of sugar and starch shows the value of cassava as food for men and for animals, and as a source from which to manufacture starch and glucose.

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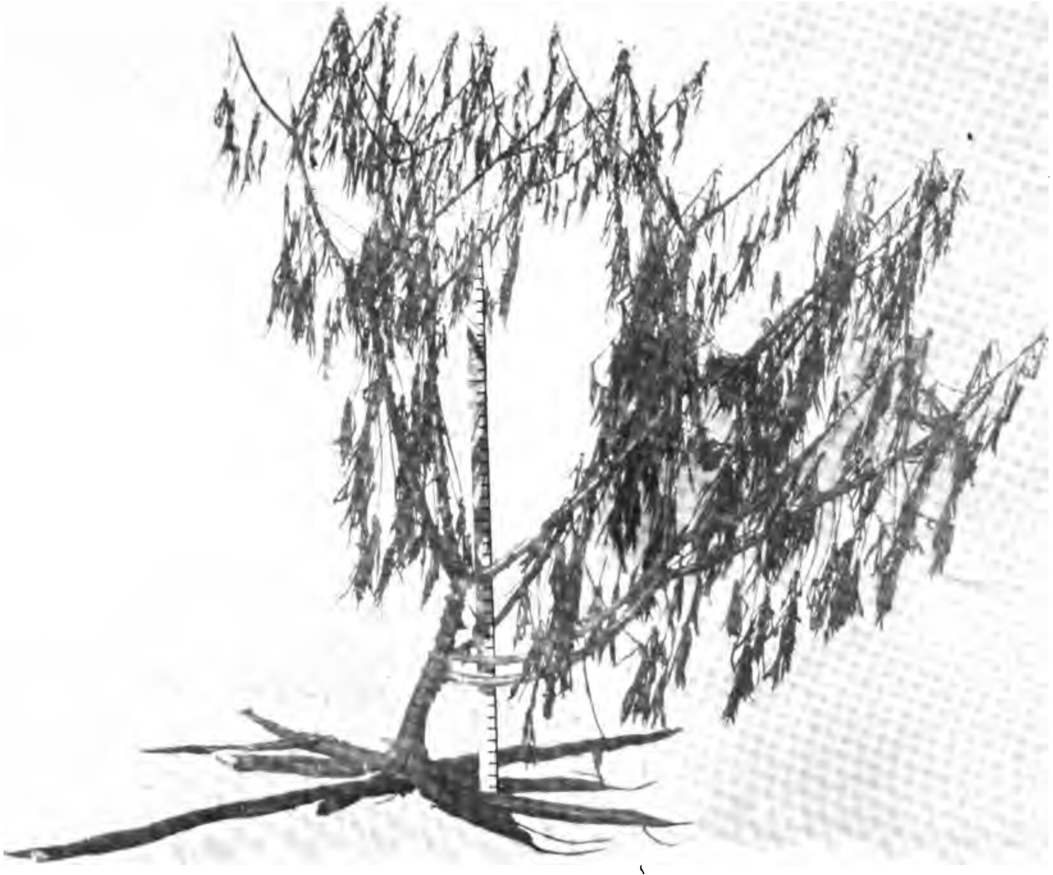
* See Bulletin No. 44, U.S. Department of Agriculture, Division of Chemistry. "Sweet Cassava: Its Culture, Properties, and Uses." By H. W. Wiley. The Lake City Station has a few copies of Professor Wiley's valuable bulletin. A copy will be sent to any applicant until the supply is exhausted.



CASSAVA PLANT.—SHOWING CANE AND ROOTS AFTER LIGHT FROST IN NOVEMBER.

The deficiency in nitrogenous matter would make it best to use with it some other food which is rich in nitrogen, such as cotton-seed meal, when fed to stock.

It would be well for parties who have cassava seed for sale to advertise the same in the Florida agricultural papers. There is some inquiry for it. The Experiment Station has sometimes given away seed, but it is not able to do so at present.

ABOUT THE CUTS.

The first cut is from a photograph taken in October, 1895 when the cassava was eight and one-half months old. It represents the average of the field, and gives a very good idea of the luxuriant habit, and the general appearance of the plant. This plant was four feet six inches in height.

The second cut shows the roots of one cassava plant, weighing nineteen pounds. A weight of root greater than this from one plant is by no means unusual. With a longer season and a better soil than ours, the weight would be much greater.

The third cut gives a view of the roots of seven plants loaded on a wheelbarrow, the aggregate weight being one hundred and nineteen and one-half pounds. From these two cuts, showing the roots, the general character of the roots is clearly seen.

The last cut, of the plant with roots, taken up just after a frost and before the leaves fell, is given for the purpose of showing the branching of the stems and their knotty appearance. It shows also the arrangement of the leaves on the stems, and the usual horizontal position of the roots, near the surface. For the photographs from which the cuts were made, I am indebted to Prof. P. H. Rolfs and Mr. A. L. Quaintance.

THE VELVET BEAN.

Early in 1895, my attention was called to a "pea" which was reported to grow luxuriantly in poor soil, to give a large amount of forage, to yield an unusual amount of peas, and to be eaten readily, both forage and peas, by all stock. The gentleman who reported this pea has no name for it. Afterwards, the same plant was found in Lake City and in other places in Florida, grown as an ornamental on trellises for shading piazzas, under the name of the Velvet Bean. Enough seed was secured from the first reporter to plant about a quarter of an acre, on very poor soil. The soil was prepared as for corn. The peas or beans were planted in rows three feet apart, and about one foot apart in the row. No special cultivation was given it; just kept free from weeds by the use of a cultivator and hoe until the plants shaded the ground. It proved to be a rampant grower. The ground was covered with a close mass of vegetation. It began to bloom in August, producing long clusters or racemes of somewhat large purple flowers, which were quite ornamental. The bloom was followed by plump pods of rich, dark green, covered with a close down, like velvet, whence probably comes the name of "velvet bean." Before frost in November, a square rod of the vines and pods gave ninety-three pounds of green forage, or 16,680 pounds per acre. I did not cure it into hay, but it would probably have dried into between two and three tons of hay to the acre. All stock readily ate the green forage, including pods with beans.

The pods are very thick and leathery; do not crack open when ripe, and are difficult to open by hand. The pods contain from three to five large, plump, fine-looking beans, irregularly colored with purplish and brownish patches. The foliage is much like that of other beans. The vines grow from ten to twenty feet in length. Left on the field, they retain the leaves and pods. The space planted to this bean has been black with the leaves and pods ever since the frosts killed the vines early in December. The beans that were ripe when frost came are apparently not injured by the winter's exposure in the fields.

I have not been able to learn the botanical name of the plant. Probably it was introduced as an ornamental climber. It may have come years ago from the Patent Office, or more recently from the Department of Agriculture. It seems worthy of further trial. Those desiring seed can procure it as mentioned below.

VALUE FOR STOCK.

An analysis of the beans, not including the shells or pods, made by Prof. A. A. Persons, gave the following results:

Analysis of the velvet bean—

Moisture, at 100° C	11.93	per cent.
Crude ash	2.02	per cent.
Crude protein	18.81	per cent.
Albuminoid nitrogen	2.87	per cent.
Crude fat (ether extract)	6.29	per cent.
Crude Fiber	7.45	per cent.
Nitrogen (free extract)	53.50	per cent.

The analysis is of an air-dried sample. Calculated to a water-free basis, and compared with an analysis of the cow pea under the same conditions, the following figures express the relative composition of the two:

	Velvet Bean.	Cow Pea.	
Ash	2.29	10.50	per cent.
Protein	21.36	14.30	per cent.
Fat	7.14	2.60	per cent.
Fiber . . . , .	8.46	29.00	per cent.
Nitrogen (free ex't)	60.75	43.60	per cent.

The nutritive ratio of a ration expresses the ratio of digestible protein to digestible carbohydrates contained in it.

The nutritive ratio of the cow pea is about 1.3. It is impossible to assign a definite nutritive ratio to the velvet bean, for the reason that, so far as I am aware, its percentage of digestibility has never been determined. The only manner of accomplishing this is by means of practical feeding experiments with stock. It is hoped that this may be done in the near future.

Assuming the digestibility of this velvet bean to be equal to that of the cow pea, it will be found that it compares quite favorably with the latter, and since it grows luxuriantly in different sections of the State, and since stock are known to feed upon it with great relish, it may perhaps play a prominent part as a forage crop in Florida in the future.

It is to be classed among those feedstuffs which are especially rich in nitrogen (protein substances). A feeding stuff so rich in nitrogen should not be fed alone,but in conjunction with some coarse fodder containing a much larger proportion of carbohydrates (starch, etc.), such, for example, as corn fodder.

MR. A. P. NEWHEART'S EXPERIENCE.

Mr. A. P. Newheart, of Ocoee, Fla., of whom I obtained the seed planted at the station at Lake City, calls the plant a pea. He writes as follows:

"Your letter is at hand. At your request I will state that I know nothing of the origin of the pea, and can find no one among the old settlers that has the least knowledge where the pea came from. It has been planted here some twenty years, solely as coverings for trellises and unsightly places. My first experience with it was to shade a pinery. I planted about a quart at the posts of the frame, which were ten by sixteen feet apart. They grew so luxuriantly, and so completely shaded the pines, that I was compelled to cut and tear away the vines in places to let in the air and sunshine.

"The abundance of foliage and vine, so completely covering the ground after the frost, suggested the idea of planting them in the orange grove as a manure, instead of buying commercial fertilizer. The result was so satisfactory that I was induced to extend my experience to another grove. I think I can safely say that no one could show up finer growth for the age of the trees than mine at the time of the last freeze. My land is high pine soil, light sand. My opinion is that the pea will do best on dry land if planted in March or April. My method is to plant at the first plowing, and to drop the seed every fourth or fifth furrow, from three to five peas in a place one foot apart, and cover with the following furrow. Nothing more was done until the pea vine commenced running. About this time the grass was three to four inches high. The cultivator was then used, but only once. After they get a good start it will require about one day to throw the vines back from the trees of a five-acre grove.

"I think it will easily average eighteen bushels of peas to the acre. But I place much more value on the vines for the amount of mulch produced, and the saving of time and money in cultivating groves. I think after the peas have been on the land for two or three years, it would be well to apply some potash.

"I will have about 200 bushels this year, would like to sell some. I sold last season for $2.00 to $2.50; will sell this season at $1.25 in hull; $1.50 if shelled. Free on cars.

MR. GREEN'S EXPERIENCE.

Mr. W. C. Green, of Orlando, has tried the velvet bean, and is strongly impressed in its favor. He writes as follows:

"Last summer when I was plowing a small piece of ground a neighbor gave me a handfull of 'Velvet Beans.' I planted them in the furrow as I went along, and covered them with the next furrow, then plowed four more furrows and planted another row. There were in all about sixty hills. Last November, just before frost, I picked off the beans, and much to my amazement, found they produced six measured bushels of beans in the pod. The vines covered the earth deep for a wide distance. When I fed them to my cows and horses they all ate them greedily. I fed them a few of the beans separately and these, also, were eaten with greed. I figured that an acre of them, at that rate, would produce a valuable amount of stock feed. They had no attention whatever, and had a lively contest with the crab grass for ascendency, but they soon 'got away' with the grass and completely overslaughed it. However, they grew on land that I had planted onions on and had fertilized well, and so might not do quite so well on unfertilized land, but I feel sure they will produce far more than any bean that I have seen grown here, and bring an immence crop of forage or vines to turn under for fertilizer, and so are a great renovating crop.

"As this is not a good grain raising country, and, as a consequence, we have to buy large amounts of oats, bran, etc., for our stock, it has struck me that this bean furnishes a solution of the feed question, and when ground would furnish the best and cheapest food for all kinds of stock that we can passibly find, fed in connection with cassava roots, artichokes, beggar weed, etc. I have been casting about for some time for something for this purpose, and am planting cassava, artichokes, etc., with view of shutting off this great expense for feed, and I would like to know how it would do to grind up these beans with the pods on, as we do corn in the cob in th

North, and feed them to stock in that condition. What do you think? If it would do, it seems to me that the velvet bean must be just the thing to fill the place of imported grain, etc. I am filling all my land with beggar weed in addition to the above, and intend, if possible, to shut out all outgo for stock feed. I forgot to say that these beans are very difficult to shell, the pod being extremely tough and leathery, and this makes it very desirable to have them ground pod and all, and so save great labor."

What Mr. Newheart says above of the value of this bean for planting in groves to shade, mulch and fertilize the ground is worthy of careful consideration. If groves can be kept in fine condition by growing this bean, or some other plant or plants, between the rows of trees, a very large sum of money can be saved to the fruit growers of the State.

Mr. Green's suggestions as to forage and grain for stock are important. How shall we keep at home the constant stream of money that now goes out of the State for hay and grain? This is a question that every thoughtful man must have asked. Undoubtedly it can be done. Perhaps this bean may be an aid in doing it.

PRICKLY COMFREY—*Symphytum officinale.*

Cut and fed in the green state the leaves and stalks of this plant are a valuable food for stock. In some portions of Europe it has been profitably grown for many years. It is also much prized by a few growers in New York and in other parts of America. But it is little known anywhere in this country. In Michigan I had some experience with it as a plant for sandy lands. Its good qualities led me to desire to try it in Florida.

The roots are fleshy, somewhat like dock. They run somewhat deeply into the soil. The plant does very well on light lands, and grows in great luxuriance on fertile soils. At first animals do not like the leaves, but a little "education" makes them extravagantly fond of them. The plant is not to be pastured. The leaves should be cut and fed in the yard or stable. In the spring of 1895 I procured a few roots from Michigan, and a few from New York, which were planted at Lake City. All the roots that came to hand in good condition began at once to grow, and grew well throughout the summer. Each root formed a luxuriant head of leaves, each leaf a foot to fifteen inches long, and an inch to two inches wide, of a dark rich green, somewhat hairy and crinkled. The leaves are not disagreeable in taste, and are quite mucilaginous. It continued to grow well throughout the fall. As the cooler weather of December and January came on it grew less luxuriantly, but has been green all winter. The outer leaves died, but the center leaves have kept fresh, and now, in the middle of February, are growing well. Work with this plant will go on another year. Roots can be procured of A. S. Cotton, Clifton Springs, N. Y., at about $2.00 per 100 sets.

TARO—(*Colocasia antiquorum.*)

In the spring of 1895, tubers of Taro were obtained from Mr. M. K. Lyman of Lantana, Fla. Planted in our land they grew well, and have increased rapidly. They have a luxuriant appearance, and seem entirely at home in their present location. Probably they would grow even more luxuriantly in good soil and in low land. Ou rainy summers seem to give them enough moisture to d well, but their natural home is in moist places.

They form numerous enlarged roots which are attached to the plant by the smaller end, the opposite, or growing end, being larger and somewhat blunt. Cooked and served like potatoes they are very good food. When boiled they are somewhat dense in texture, but tender. Perhaps these, like many other kinds of food, require a certain familiarity before they are well liked. Those who have eaten them at my table have thought them not as desirable as sweet potatoes or Irish potatoes. But I think their good qualities would make them acceptable to most people after a short acquaintance. After a patch of them is once established they can be dug up any day in the year, and thus supply the table whenever desired.

They are excellent food for all kinds of stock, and, judging by their growth and yield for one summer, they can probably be grown profitably for this purpose.

Taro is much grown in some sections for food. It is botanically a near relative of the Calladiums which are so much grown for ornament in grounds and green-houses, and is a fine-looking plant itself, having a strikingly tropical aspect. The Taro is *Colocasia antiquorum.* The Tanyah, used so much for ornament, is *Colocasia esculentum.* This has run into many beautiful varieties. *Caladium esculentum* is the same as *Colocasia esculentum.*

TROPICAL YAM—(*Dioscorea sp.*)

There are many yams of different species cultivated in different parts of tropical and sub-tropical countries. The yam now being tried at the Lake City Experiment Station was found growing in the grounds of Mr. Gardner, at Fort Myers. He considered it valuable, and generously supplied the Station with seed. It was planted on poor land in rows six feet apart, and six feet apart in the row. It was fertilized with a small amount of stable manure and acid phosphate, and given a low trellis to cling to.

It grows in rampant fashion, the vines being from ten to twenty feet in length. The season of freedom from frost here does not seem to be long enough for it to form any aerial tubers in the axils of the leaves, as only a few have appeared in the axils of lower leaves. These aerial tubers are used for seed. It is probable that the plant could be rapidly propagated by cuttings of the vine, as these have a strong tendency to root at the joints, whereever the vine rests on the ground.

A growth of one season gives yams as heavy as two pounds. When broken these yams are very mucilaginous. Boiled like potatoes they are very palatable and wholesome food. They keep in the ground from year to year without becoming woody, and constantly increase in size. A small patch of them grown in the garden would yield every day in the year an excellent food for the table, by digging as wanted. Taking the yam does not injure the growth of the remainder of the plant, if the roots are not much disturbed. Many old Floridians in all parts of the State now grow yams for family use. Newcomers may find it profitable to cultivate a patch for this purpose. They are excellent food for all kinds of stock, but possibly it would not be profitable to cultivate them for this purpose only, as there are other crops which might give larger returns. Further work in methods of propagating, cultivating, and learning the yield of one season's growth will be done with the yam we now have, and with others as they can be procured.

CANAIGRE.—(*Rumex hymenosepalus.*)

Canaigre belongs to the same genus of plants as the common dock which is so abundant in some parts of the States. It grows wild in Arizona, New Mexico, and some other sections of the great Southwest. Its leaves grow in a cluster at the surface of the ground. They are light green in color, quite succulent, and may be boiled for "greens" like the leaves of the yellow dock. On pine land here in Florida it throws up a flower-spike of two to two and a half feet high, and produces an abundance of seed. Its roots when young are yellowish-red outside, and darker red within; they are shaped somewhat like a sweet potato, tapering at both ends. As the roots grow older they become darker in color. These roots are very rich in tannic acid. In the Southwest the wild roots are gathered in large quantities, are sliced, dried in the sun, and shipped to markets in the East or to Europe, to be used for tanning. Near localities where large quantities of the wild roots grow, factories have been built, in a few instances, to extract the tannin from the roots. The tannin is then shipped in barrels to the markets, thus making a great saving in the cost of transportation.

Attention has been turned within a few years to the cultivation of Canaigre, and large plantations of it are already planted, and many others are planned and will soon be planted. It can be grown from seed; but, usually, wild roots are obtained and planted. As the roots increase somewhat rapidly, the planting of roots has thus far been the best way of starting. Should the demand for the plant increase rapidly it will, doubtless, be easily grown from seed on a large scale. If grown from seed, probably the best way will be to sow the seed about as onion seed is sown, cultivate carefully for a year, and then transplant to the fields.

In the spring of 1894 I obtained a few roots through the courtesy of the Directors of the Experiment Stations at Mesilla Park, New Mexico, and Tucson, Arizona. These came to me by mail. They were small, dry and wrinkled, having little appearance of life. They were planted in rows three feet apart, and two feet apart in the rows. About a shovelfull of stable manure was given each root. They grew at once, gave some bloom, and seemed in all respects healthy and at home. The seeds were ripe about the middle of May, and soon after the leaves turned yellow and died. Through the summer there was no sign of the plants above ground, but the roots seemed all right.

In the fall of 1894, in October, the leaves again appeared, and grew well all winter. The freezes cut them somewhat, but they recovered immediately, and made a good growth. Again, after the seed was ripe in May, 1895, the plants died to the ground. Examination showed the roots in healthy condition, the old ones increased in size, and many new ones formed. In October, 1895, the growth begun again, and now (February, 1896,) the plants are looking well. There are a good many small roots, about the size of the thumb. The old roots are much larger, and of a much darker color. The ground has been kept free from weeds, and a shovelful of manure given once a year.

There is every promise that this plant will grow well in Florida. The roots have a very acrid taste, indicating that they are well charged with tannic acid. We have in Florida great quantities of saw palmetto, the roots of which are rich in tannin. It would be well to be quite sure that it is more profitable to cultivate Canaigre, as a source of tannin, than to secure it from the saw palmetto, before going extensively into the growth of Canaigre. Why not establish factories to extract the tannin from the palmetto?

The Florida Experiment Station has only a few roots of Canaigre. It has none for sale, or to give away. Probably any one who desires to try the plant can learn the names of parties from whom roots can be obtained by addressing the Directors of the Experiment Stations in Arizona and New Mexico.

ALFALFA—(*Medicago sativa*).

Several sowings of Alfalfa seed were made in the fall of 1894 and the spring of 1895. It was sown on sandy land, fertilized with 350 pounds per acre of the following mixture:

Acid phosphate,	150 lbs.
Sulphate of potash,	100 lbs.
Cotton-seed meal,	100 lbs.
	350 lbs.

As the main purpose was to learn if Alfalfa would thrive at all, the seed was sown in drills, so as to be able to keep it free from weeds, and give it every chance to do well. The seed germinated quickly. The young plants were quite tender, easily cut down by frost. But the seed sown so late that the plants were not touched by frost grew well. By July it was twelye to fifteen inches high, with a healthy look, A part of it was mown, and a part left uncut. During the summer and fall the plants nearly all died. This spring only a few roots show any sign of life. Perhaps on other soils in Florida it may do better. Thus far it gives no promise here.

FLAT PEA.—(*Lathyrus silvestris.*)

Great claims are made for this plant as a forage crop. I grew it at the Experiment Station in Michigan with success. In the spring of 1894 seed were procured and sown on our Station farm at Lake City. It germinated, but as soon as it appeared above ground it died. Apparently it was killed by the sun.

In the fall of 1894 and the winter of 1895 several sowings were made. The seed grew well whether sown early or late. The earliest sowings were three or four inches high when the severe freeze of December, 1894, came. The plants were not killed, but during the colder portion of the winter they made very slow growth. Plants from seed sown February 1st were as large in May as were those from seed sown in the previous October. In late spring and early summer the plants grew slowly, and gave little promise. In mid-summer, and later, they turned yellow and withered. All died. By November not a plant was alive.

In the spring of 1895 I obtained a few roots of this plant from Michigan and a few from Nebraska. Good care was given them, and they grew well; looked healthy. But during the winter just passed they grew very little, and now (February, 1896), some of them are dead, and others look as if preparing to follow their dead companions. Many dealers in seeds now offer the seed of this plant, and anyone wishing to try it can probably procure seed through them. It would be well to try the plant on some of the soils of West Florida. Its forage has a very high feeding value, and it yields heavily when it grows well. It is a perennial. Once established it would continue indefinitely. It is a misfortune that it does not seem to be at home on our soil and in our climate.

SACHALINE.—(*Polygonum Sachalinense.*)

In the spring of 1894, when so much was said in the agricultural press about this new forage plant, I sent for some roots of it. They grew at once, with no special care. After a few months the party of whom I bought wrote that he had been misled by a dealer, and had not sent me the true scahaline. In the spring of 1895 some true roots were obtained. These grew well, though not with special luxuriance. But they formed the most astonishing mass of roots.

The young stems are very vigorous and succulent. When two or three feet high the stems begin to get woody, but still are readily eaten by all kinds of stock. Probably they should be cut for green forage before the stems have become too woody. The foliage was killed by the first frosts. The new growth showed above ground February 20. The new shoots are very numerous. Examination of the roots at different times during the winter had shown that they were thickly set with buds.

It is clear that this plant once established will be very difficult to eradicate. But it produces a large amount of foliage which is eaten by stock with avidity. If the foliage proves to have a high nutritive value for animals, a grower having a field of it would not want to eradicate it. On most farms there are locations that could be profitably given to a plant that required no attention, and that would yield a fair amount of stock food. The permanent value of this plant remains to be proven. Those liking to experiment might secure a few plants and try it in locations from which they will not want to dislodge it. Most of the nurseries now offer for sale both plants and seeds.